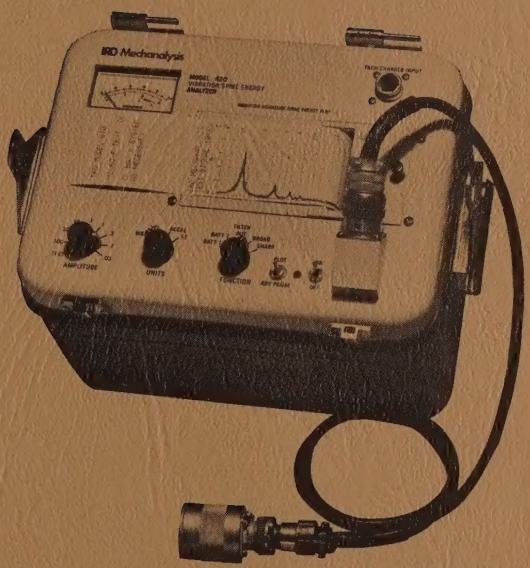
IRD Mechanalysis



SERVICE MANUAL FOR MODEL 820/820M VIBRATION/SPIKE ENERGY ANALYZER

SERVICE MANUAL
FOR
MODEL 820/820M
VIBRATION/SPIKE ENERGY ANALYZER

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INTRODUCTION

This service manual provides complete information for troubleshooting, servicing, and calibrating the Model 820 Vibration/Spike Energy Analyzer. The information contained in this manual is divided into two chapters as follows:

Chapter I, CALIBRATION AND EVALUATION, provides complete set-up instructions for calibrating and testing the 820 instrument circuits. The overall performance of the instrument is evaluated on a step- by-step basis, and calibration adjustments may be performed as needed at various points in the procedure.

Chapter II, SERVICE, provides complete information on the instrument circuits and circuit components. Board-level procedures are listed for troubleshooting and calibrating the 820 Filter PC Board, and Parts Lists are included along with the corresponding component layout illustrations for the various PC Boards. The Electrical Block and Schematic Diagrams are also provided in this chapter.

Appendix A consists of a listing of all changes and corrections included in the manual. The changes are keyed to the ECO (Engineering Change Order) number specifying or authorizing the change. The highest ECO number listed is keyed to the Prefix Letter printed on the face page of this manual.

CAUTION:

NO ATTEMPT TO CALIBRATE THIS UNIT SHOULD BE MADE EXCEPT BY AN EXPERIENCED, QUALIFIED TECHNICIAN, USING THE PROPER TEST EQUIPMENT. IRD MECHANALYSIS, INC. ASSUMES NO RESPONSIBILITY FOR THE OPERATION OF UNITS REPAIRED OR CALIBRATED OUTSIDE THE FACTORY OR CUSTOMER SERVICE AGENCIES.

1 CALIBRATION AND EVALUATION

1.1 TEST EQUIPMENT REQUIRED

1) Digital Voltmeter (DVM) - Fluke 8600A or equivalent.
2) Frequency Counter - Fluke 1900A, HP 5302A or equivalent.
3) Signal Generator - Wavetek 184 or equivalent.
4) Precision 10:1 Voltage Divider
5) Vibration Signal Input Connector - P/N 19648

1.2 INSTRUMENT SETUP

1. Instrument Disassembly - To gain access to the calibration controls and other internal assemblies, the instrument case must be separated from the chassis. To accomplish this, remove the battery from the battery compartment and loosen the four (4) securing screws at the bottom of the case. The instrument can then be lifted out of the case. NOTE: The battery pack must be installed and fully recharged before the instrument can be calibrated.

2. PC Board and Calibration Control Locations - The locations of the 820 PC Boards and calibration controls are shown in Figure 1-1, Page 1-2. This illustration should be referred to throughout the calibration procedure. In Figure 1-1, the component reference numbers (C304, R502, etc.) correspond to the series numbers of the PC Boards on which the components are located.

CAUTION: The CMOS chips used in the 820 instrument can be damaged by static electricity. Always use anti-static protection when handling the PC Boards or replacing components.

1.3 POWER SUPPLY CALIBRATION AND TEST

1. Adjust the mechanical zeroing screw on the 820 Amplitude meter face as needed for a reading of 0.0 .

2. Set the 820 POWER switch to ON, and check that the battery pack is fully charged. Briefly allow the instrument to warm up, then measure and calibrate the power supply voltages as listed below in Table 1-1. The DVM (-) lead is connected to the negative terminal of the 820 Amplitude meter (the terminal with the black wire attached) for all measurements. Figure 1-2. Page 1-3, describes the location of the power supply test points and calibration controls.

TABLE 1-1 POWER SUPPLY CALIBRATION

DVM (+) LEAD	ADJUSTMENT CONTROL	DC VOLTAGE VALUE
J101-PIN 6	(No Adjust.)	+ 2.40 to +2.60
J101-PIN 1	R130	-15.0 ±.25
J101-PIN 2	R128	+15.0 ±.25
J101-PIN 5	R105	+ 5.00 ±.25

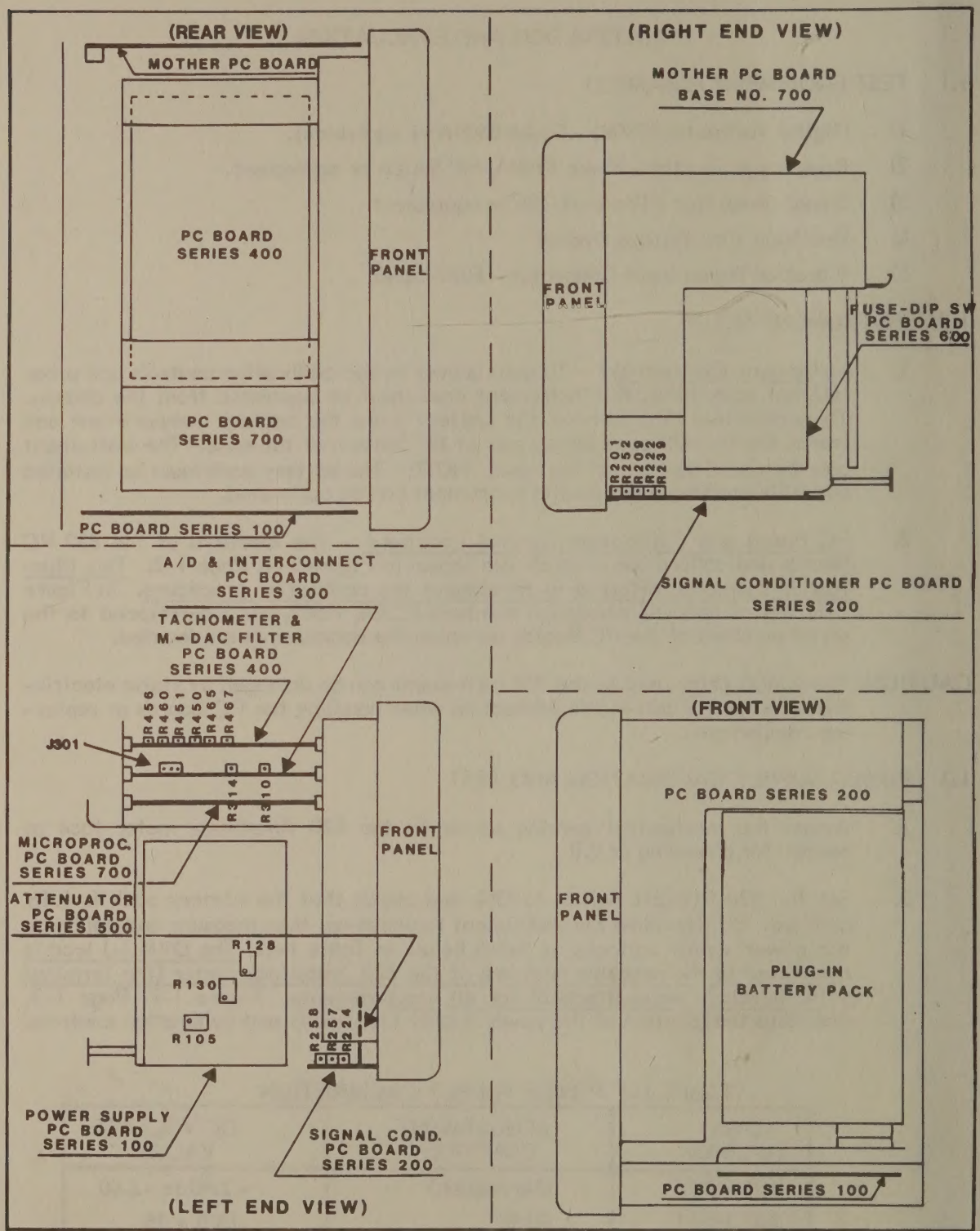


FIGURE 1-1 MODEL 820 PC BOARD AND CALIBRATION CONTROL LOCATIONS

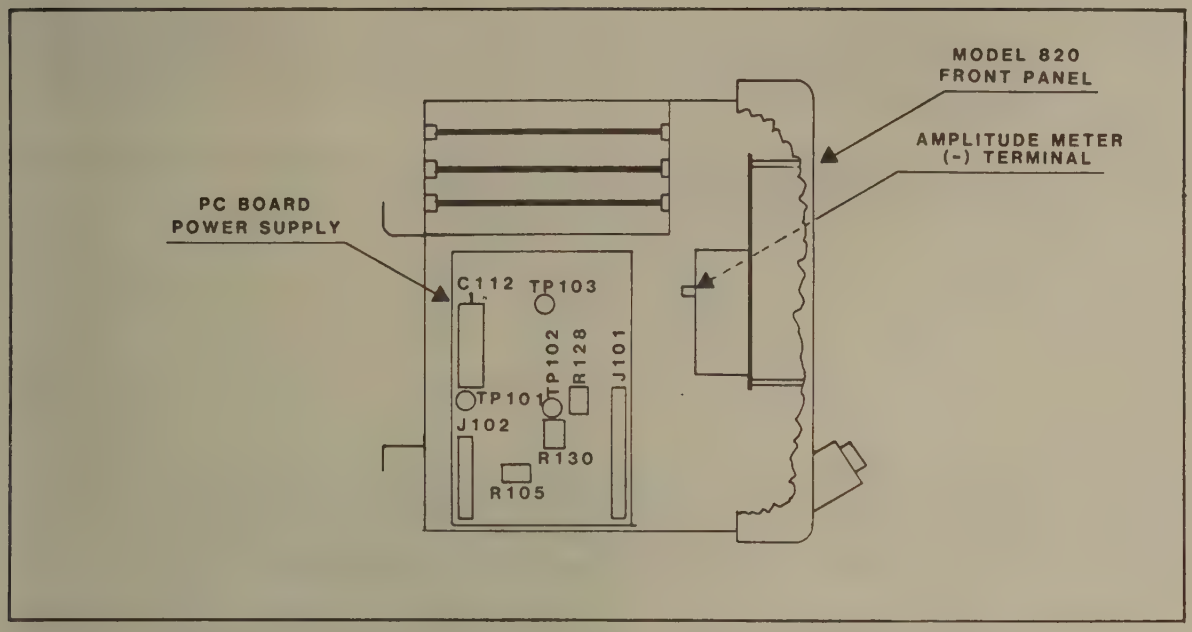


FIGURE 1-2 POWER SUPPLY TEST POINT AND CALIBRATION CONTROL LOCATIONS

1.4 MICROPROCESSOR EVALUATION

1. Set up the 820 controls as follows:

   AMPLITUDE: "1" ("1 g" metric)
   UNITS: ACCEL
   FUNCTION: FILTER OUT
   PLOT SPEED: MEDIUM (FAR RIGHT)

2. Set the power switch to ON, and verify that a tape is printed out in seven (7) seconds or less. The red LED must be lit while the printer is generating the tape, and must start flashing when the printer stops. The tape that is printed out should appear as follows:

```
IRD MODEL 820

MICRO-P TEST: OK


CK BAT & SYSTEM
AS NECESSARY
```

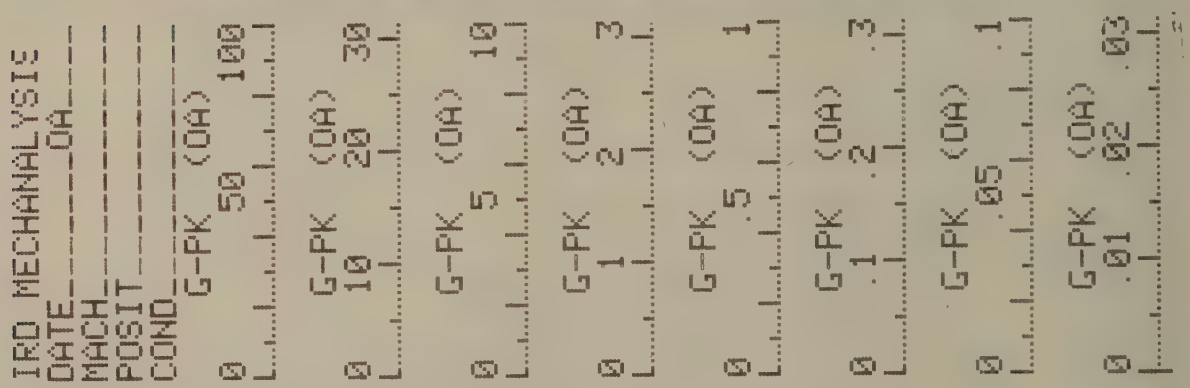
3. Momentarily press the Power Interrupt Switch down. (This switch is located to the right of the signal input connector.) A tape should be generated as in Step 2, Page 1-3.

4. Set the AMPLITUDE switch to TEST, and momentarily set the PLOT switch to PLOT. The following message should be printed out:

```
IRD MECHANALYSIS
TEST SIGNAL  (0A
0       .5
|....|....|....|....|....|....|....|....
```

Stop the printer by again moving the PLOT switch to PLOT.

5. Set the AMPLITUDE switch to "100." Toggle the PLOT switch to PLOT. While the tape is being printed out, momentarily set the Amplitude switch to each lower range position by slowly rotating the switch in the clockwise direction. The tape that is printed out should appear as follows:



6. Set up the 820 UNITS and FUNCTION switches as listed below, and toggle the PLOT switch to generate a printout for each switch setup. The resulting printouts must list the error message shown at the top of Page 1-5.

UNITS SETTING	FUNCTION SETTING
DISPL	FILTER OUT
ACCEL	BATT 1
ACCEL	BATT 2
ACCEL *	FILTER OUT *

* For this setup, also connect Pin F to Pin A on the Pickup Input connector.

6. (Continued)

```
OPERATOR ERROR -
IMPROPER SWITCH
CONFIGURATION
```

7. Set the UNITS switch to DISP and the AMPLITUDE switch to "1" ("1 g" metric), also jumper Pin F to Pin A on the Pickup Input connector. Start the printer by pressing the PLOT switch to PLOT. The printout obtained should appear as follows:

```
IRD MECHANALYSIS
DATE_______OA____
MACH_____________
POSIT____________
COND_____________
 MILS P-P  (OA)
0       .5
```

FOR ENGLISH

```
IRD MECHANALYSIS
DATE_______OA____
MACH_____________
POSIT____________
COND_____________
  UM P-P  (OA)
0   10    20   30
```

FOR METRIC

8. Set the UNITS switch to VEL, and start the printer. The printout obtained must appear as follows:

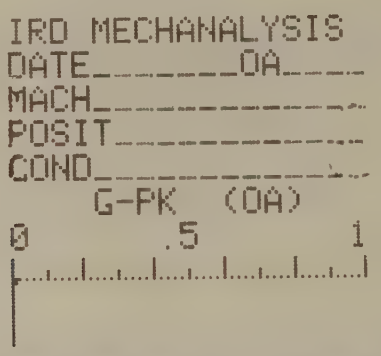
```
IRD MECHANALYSIS
DATE_______OA____
MACH_____________
POSIT____________
COND_____________
 IN/SEC PK  (OA)
0       .5
```

FOR ENGLISH

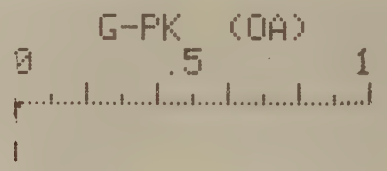
```
IRD MECHANALYSIS
DATE_______OA____
MACH_____________
POSIT____________
COND_____________
 MM/SEC PK  (OA)
0   10    20   30
```

FOR METRIC

9. Set the UNITS switch to ACCEL, and disconnect the jumper between Pins F and A on the input connector. Start the printer, but do not stop it. The printout obtained must appear as follows:



10. Momentarily set the PLOT switch to ADV/PAUSE. The printer must stop printing. Restart the printer by pressing the PLOT switch to PLOT. The printout obtained must appear as follows:



11. Stop the printer, then hold the PLOT switch to ADV/PAUSE. The printer must advance the paper.

12. Set up the 820 controls as follows:

AMPLITUDE: "1" ("1 g" metric)
UNITS: ACCEL
FUNCTION: FILTER OUT

13. Toggle the PLOT switch to PLOT, and observe that the following printout is generated. Stop the printer after 30 seconds has elapsed.

1.5 SIGNAL CONDITIONER CALIBRATION

1. Set the 820 AMPLITUDE switch to "1" ("1 g" metric), the UNITS switch to ACCEL, and the FUNCTION switch to FILTER OUT.

2. Connect the signal generator, the DVM, and the frequency counter to the 820 instrument as shown below in Figure 1-3. The generator output leads should be connected to the Pickup Input connector using the 970 input configuration as follows:

   SIGNAL (+) LEAD - PIN C
   SIGNAL GROUND - PINS A, K*

   * Also, connect Pins D and E to Pin A through 2.67K ohm resistors.

   Adjust the generator to obtain the following output signal at the input connector:

   SIGNAL GENERATOR OUTPUT

   SIGNAL FREQUENCY - 100 Hz
   SIGNAL AMPLITUDE - 35.4 mV RMS

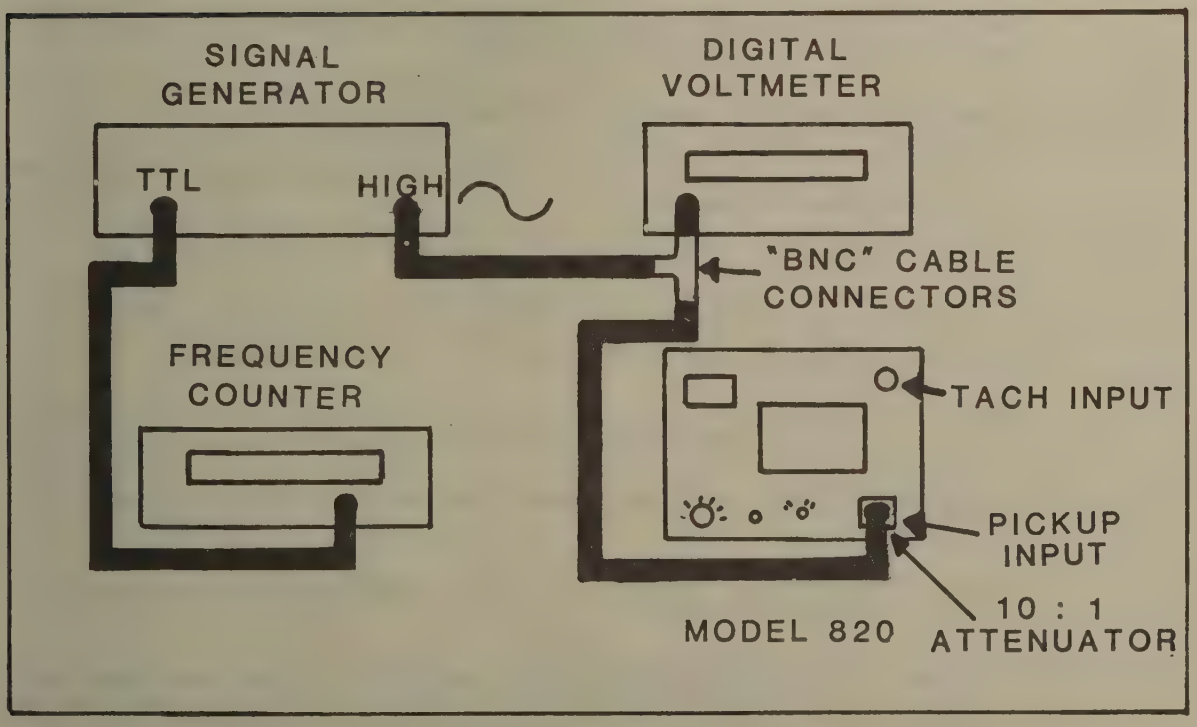


FIGURE 1-3 SIGNAL GENERATOR INPUT CONNECTIONS

3. Connect the DVM (+) lead to Pin 3 of J301, and connect the (-) lead to the signal generator common. The location of J301 (on the A/D and Interconnect PC Board) is shown in Figure 1-1, Page 1-2.

4. Adjust R222 for a DVM reading of 1.00 ±.02V DC at J301-3.

   Adjust R258 for a reading of "1.00" on the 820 Amplitude meter.

5. Set the UNITS switch to VEL, and adjust the generator for an output signal of 57.5 mV RMS (71.7 mV metric) at 100 Hz.

6. Adjust R209 for a DVM reading of 1.00 ±.02V DC at J301-3.

7. Connect the generator output leads to the Pickup Input connector using the 544 configuration as follows:

   SIGNAL (+) LEAD - PIN B
   SIGNAL GROUND - PINS A, C, F, K*

   * Also, connect Pins D and E to Pin A through 2.67K ohm resistors.

   Adjust the generator for an output signal of 764 mV RMS (951 mV Metric) at 100 Hz.

8. Adjust R252 for a DVM reading of 1.00 ±.02V DC at J301-3.

9. Set the UNITS switch to DISPL, and adjust the generator for an output signal of 240 mV RMS (299 mV metric) at 100 Hz.

10. Adjust R201 for a DVM reading of 1.00 ±.02V DC at J301-3.

11. Connect the signal generator output leads to the Pickup Input connector using the 970 configuration as follows:

    SIGNAL (+) LEAD - PIN C
    SIGNAL GROUND - PINS A, K*

    * Also connect Pins D and E to Pin A through 2.67K ohm resistors.

    Set the UNITS switch to SE, and adjust the signal generator for an output signal of 18.0 mV RMS at 10 KHz.

12. Adjust R239 for a reading of 0.50 ±.03 on the 820 Amplitude meter (0 to 1 scale).

    NOTE: The frequency counter must not be connected to the signal generator when adjusting R239.

13. Decrease the signal generator output frequency until the Amplitude meter indicates a reading of 0.35 (on the 0 to 1 scale). At this amplitude level, the frequency counter must indicate a reading of 4.2 KHz to 6 KHz.

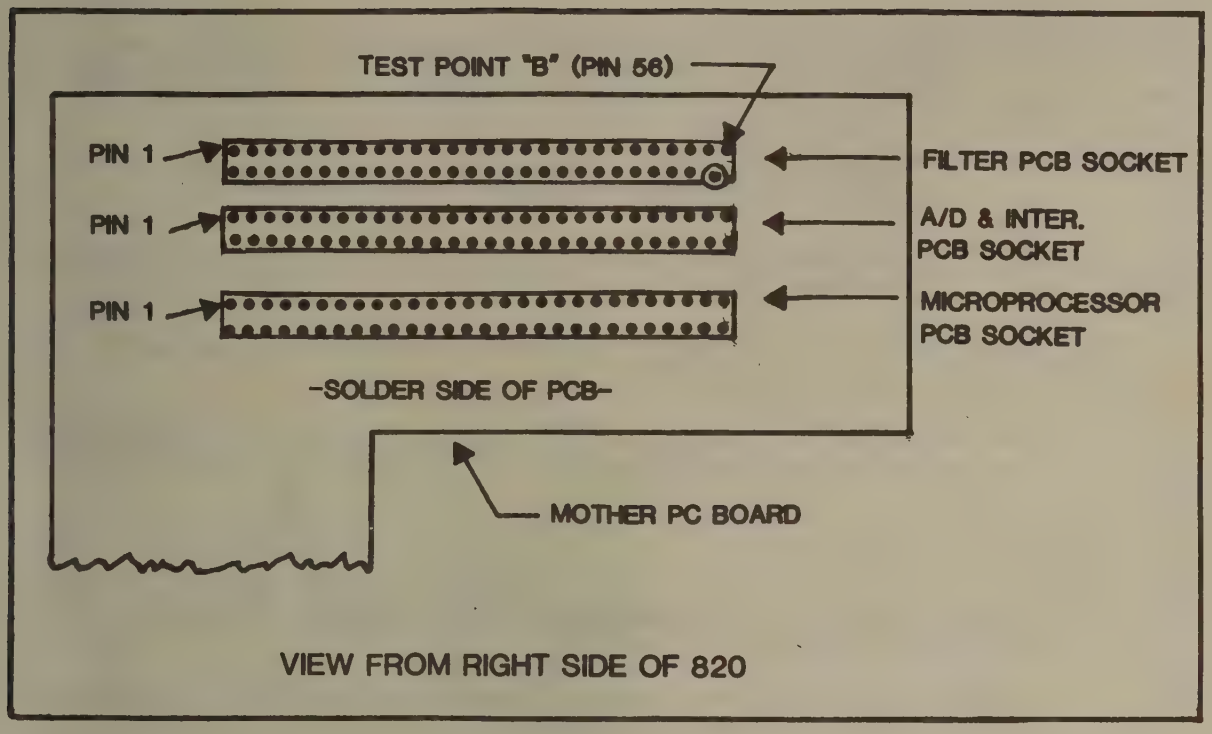


FIGURE 1-4 LOCATION OF TEST POINT B

14. Set the AMPLITUDE switch to TEST and the UNITS switch to ACCEL. Connect the frequency counter (+) input lead to Test Point B as shown in Figure 1-4. The (-) lead is connected to Pin 7 of TP402 (on the Tach and M-DAC Filter PC Board.)

15. Adjust R257 for a reading of 50.0 m/sec on the frequency counter. Disconnect the frequency counter test leads.

16. Adjust R224 for a DVM reading of 0.800 VDC at J301-3. Disconnect the DVM test leads.

1.6 CONTROL/INTERFACE PC BOARD CALIBRATION

1. Connect Pin C to Pin A (ground) on the Pickup Input connector, and set up the 820 controls as follows:

FUNCTION:	FILTER OUT
UNITS:	ACCEL
AMPLITUDE:	"100" ("100g" metric)

2. Start the printer by pressing the PLOT switch t oPLOT. Adjust R314 so that the plotted trace just falls on the 0 baseline, then stop the printer.

3. Connect the signal generator to the 820 input using the 970 configuration (Pin C connected to (+) signal), and adjust the generator for the following signal at the connector:

   SIGNAL AMPLITUDE - 35.4 mV RMS*
   SIGNAL FREQUENCY - 100 Hz

   * NOTE: Disconnect the frequency counter while adjusting the amplitude to avoid noise pickup.

4. Start the printer, and adjust R310 so that the plotted trace just falls on the full scale line. Stop the printer.

5. Set the AMPLITUDE switch to TEST, and start the printer. The amplitude level plotted on the printout should be at .8 (±2 divisions). Stop the printer.

1.7 MODEL 820 NOISE TEST

1. Connect Pin A to Pin C on the Pickup Input connector, and set the AMPLITUDE switch to ".03" (".03g" metric).

2. Observe the 820 Amplitude meter - the meter should indicate a reading of 2 small divisions or less on the 0 to 1 scale.

3. Start the printer. The printout must indicate an amplitude reading of 2 small divisions or less. Stop the printer.

4. Set the UNITS switch to VEL, and repeat Steps 2 and 3.

5. Connect Pins B, F and A to Pin C on the Pickup Input connector, and observe the 820 Amplitude meter reading. The meter should indicate a reading of 5 small divisions or less on the 0 to 1 scale. NOTE: Pin K is open, and Pins D and E are connected to Pin A through 2.67K ohm resistors.

6. Start the printer. The printout must indicate an amplitude reading of 4 small divisions or less. Stop the printer.

7. Set the UNITS switch to DISP, and observe the 820 Amplitude meter. The meter must indicate a reading of 6 small divisions or less on the 0 to 1 scale.

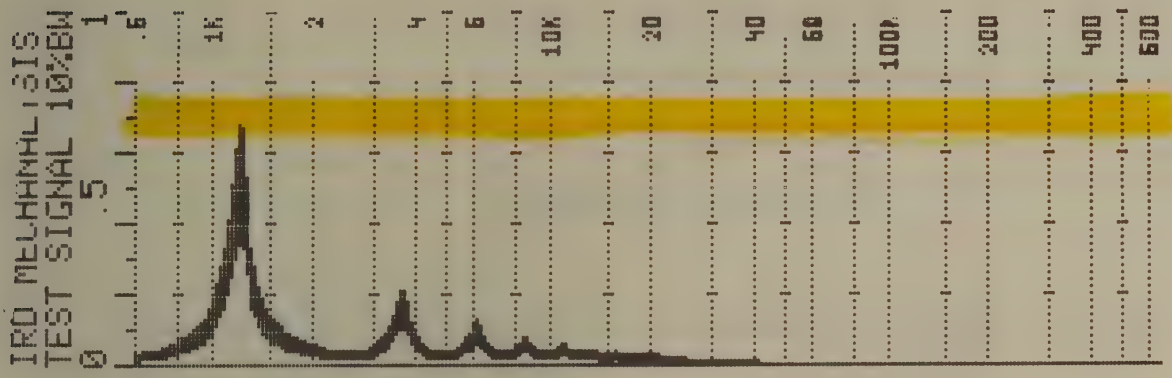
8. Start the printer. The printout must indicate an amplitude reading of 6 small divisions or less. Stop the printer.

1.8 FILTER RESPONSE TEST

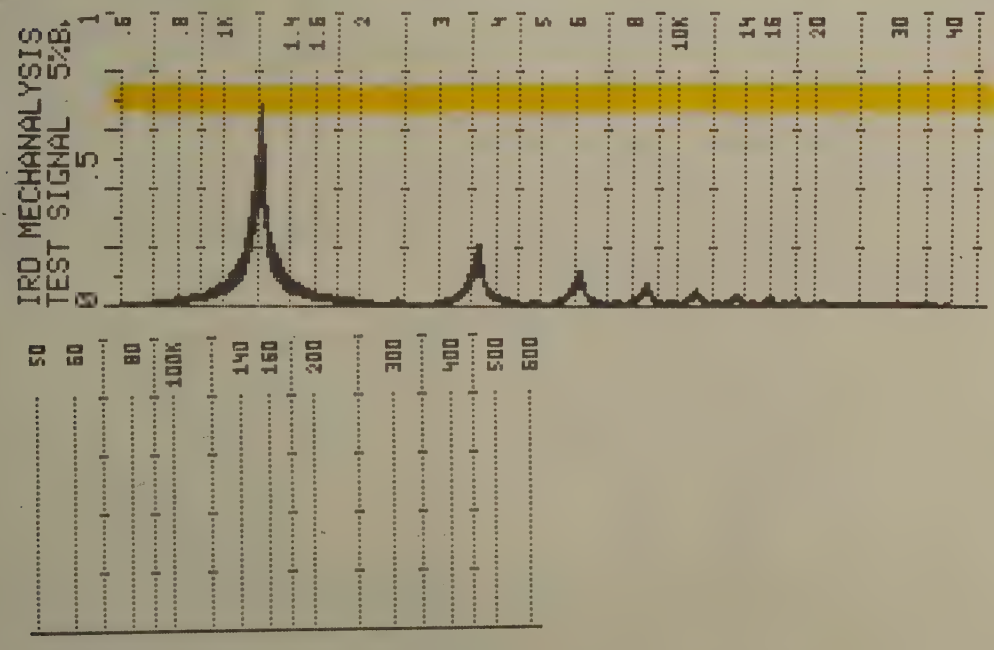
1. Set up the 820 controls as follows:

AMPLITUDE:	TEST
UNITS:	ACCEL
FUNCTION:	BROAD

2. Start the printer. After the test curve is plotted out, the printer must stop just beyond the 600K CPM marker. The amplitude peak must occur at the 7th minor column, ±2 minor columns, after the IK CPM marker. The peak amplitude value must be from .660 to .760, and no baseline noise peaks or "bumps" must be indicated beyond the point specified on the printout below. A typical 820 test plot in the BROAD mode is shown as follows:



3. Set the FUNCTION switch to SHARP, and start the printer. The printout that is generated must appear as follows. The printer must stop after the 600K CPM marker. The peak of the curve must occur at the 11th minor column, ±2 minor columns from the IK CPM marker, and the amplitude value of the peak must be from .660 to .760.



1.9 TACH INPUT TEST

1. Connect the signal generator output leads to the Tach Input connector as follows:

Tach Input Configuration

GENERATOR (+) LEAD - PIN 4
GENERATOR COMMON - PIN 1

2. Set up the 820 controls as follows:

AMPLITUDE:	"1" ("1g" metric)
UNITS:	ACCEL
FUNCTION:	FILTER OUT

3. Adjust the signal generator to obtain the input signals listed in Table 1-2. For each frequency setting, start the printer to obtain the RPM reading, then stop the printer. The corresponding RPM readings must be within the limits specified in the table.

TABLE 1-2 RPM READOUT TEST

GENERATOR OUTPUT FREQUENCY AT 1.00V RMS	820 RPM READING
60 Hz	3586 to 3613 CPM
500 Hz	29960 to 30040 CPM
1K Hz	59930 to 60070 CPM
1.5K Hz	89900 to 90100 CPM

4. Disconnect the signal generator output leads from the Tach Input connector. Start the printer, and verify that the printout message does not contain the "RPM" header. Stop the printer.

5. Connect the DVM test leads to the Tach Input connector as described in Table 1-3. For each connection listed, the corresponding voltage reading must be within the specified limits.

TABLE 1-3 TACH INPUT VOLTAGE TEST

DVM CONNECTION (+) LEAD	(-) LEAD	DC VOLTAGE READING
PIN 2	PIN 1	+ 4.90 to 6.90
PIN 3	PIN 1	+11.40 to 13.70
PIN 5	PIN 1	+ 4.85 to 5.15

6. Connect the DVM test leads to the Pickup Input connector, and check for the required voltages as follows:

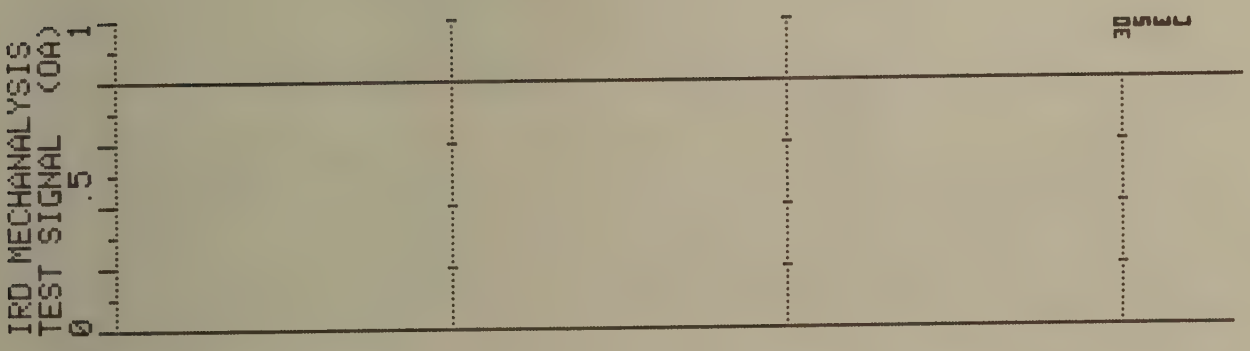
DVM CONNECTION	VOLTAGE VALUE
PIN D (+)/PIN A (-)	+12.00 to +12.80 VDC
PIN E (+)/PIN A (-)	-12.00 to -12.80 VDC

1.10 PLOT SPEED TEST

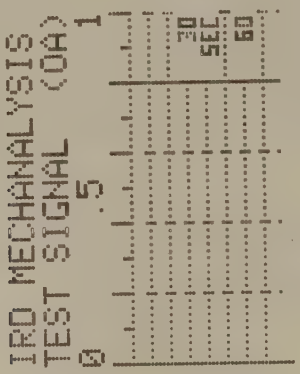
1. **Set up the 820 controls as follows:**

AMPLITUDE:	TEST
FUNCTION:	FILTER OUT
UNITS:	ACCEL
POWER:	ON

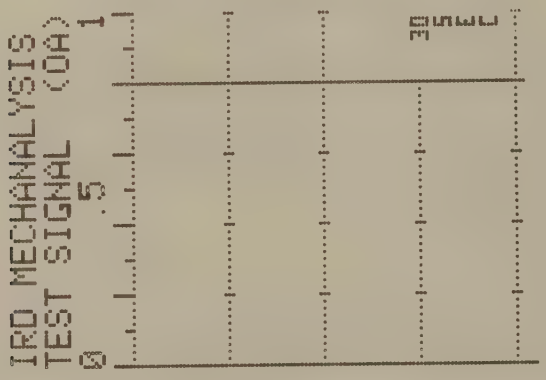
2. Set the Plot Speed switch to the left (fast) position. Start the printer, and allow it to operate for 30 to 40 seconds. The resultant plot must appear as follows:



3. Set the Plot Speed switch to the center (slow) position, and repeat Step 2. The resultant printout must appear as follows:



4. Set the Plot Speed switch to the right (medium) position, and repeat Step 2. The resultant printout must appear as follows:



NOTE: The calibration adjustments and evaluation tests for the 820 instrument are now completed.

II SERVICE

2.1 GENERAL

This chapter contains complete information for troubleshooting and servicing the Model 820 circuits. In Sections 2.2 and 2.3, calibration procedures and a troubleshooting guide are provided for servicing the M-DAC filter circuit. The calibration procedures listed in Section 2.2 are for adjusting factory-set controls on the Tach and M-DAC Filter PC Board, and should be used only when defective components are replaced on this PC Board. The Parts Lists and Component Location Illustrations for the various PC Boards are listed in Section 2.4, and the Electrical Block and Schematic Diagrams of the 820 circuits are provided in Section 2.5.

2.2 TACH AND M-DAC FILTER PC BOARD CALIBRATION

1. Test Equipment Required -

   a) Digital Voltmeter (DVM) - Fluke 8600A or equivalent
   b) Frequency Counter - HP5302A or equivalent
   c) Signal Generator - Wavetek 180 or equivalent
   d) Precision 10:1 Voltage Divider
   e) Oscilloscope - Tektronix 5110 or equivalent
   f) 10 Pin Plug-In Connector - P/N 25742
   g) 8 Contact DIP Switch - P/N 24087 (Optional)
   h) Vibration Input Connector - P/N 19648

2. Instrument Setup - When called for in the procedure, a Test DIP Switch assembly is to be connected to the header J608 on the Fuse PC Board. This switch is used to encode digital set-up numbers into the microprocessor circuits. The details of the switch connections are shown in Figure 2-1. As an alternative to the DIP switch listed above, an assembly consisting of 8 toggle switches mounted together may be used. NOTE: In instruments prior to Serial Number Prefix "C", this DIP switch is mounted on the Fuse PC Board and is accessible through the battery compartment.

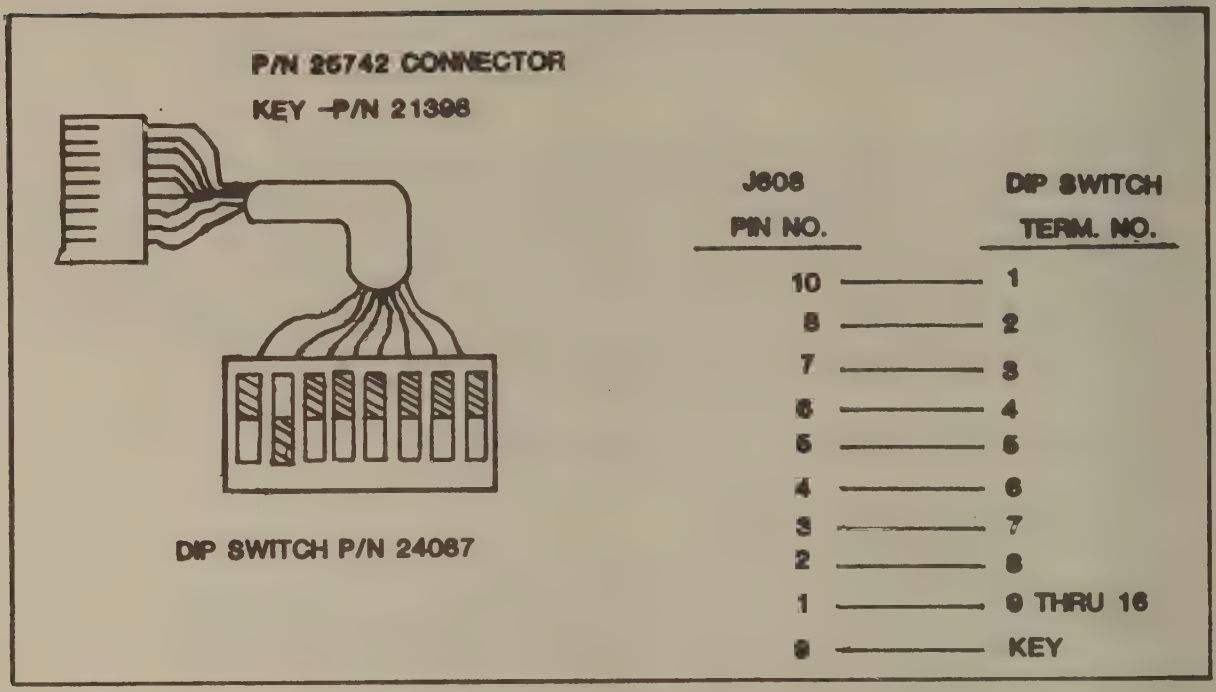


FIGURE 2-1 TEST DIP SWITCH ASSEMBLY DETAILS

3. M-DAC Filter Calibration Procedure -

a) Set up the 820 controls as follows:

FUNCTION:	FILTER OUT
UNITS:	ACCEL
AMPLITUDE:	TEST

b) Connect the test jumpers J204, J205 and J206 as follows. The locations of these connectors are shown in Figure 2-2, Page 2-3.

Test Jumper Setup

J204 - Connect Jumper to Pins No. 1 and 2
J205 - Disconnect Jumper
J206 - Leave Jumper connected to Pins No. 2 and 3

NOTE: Disconnecting Jumper J205 disables the test signal oscillator.

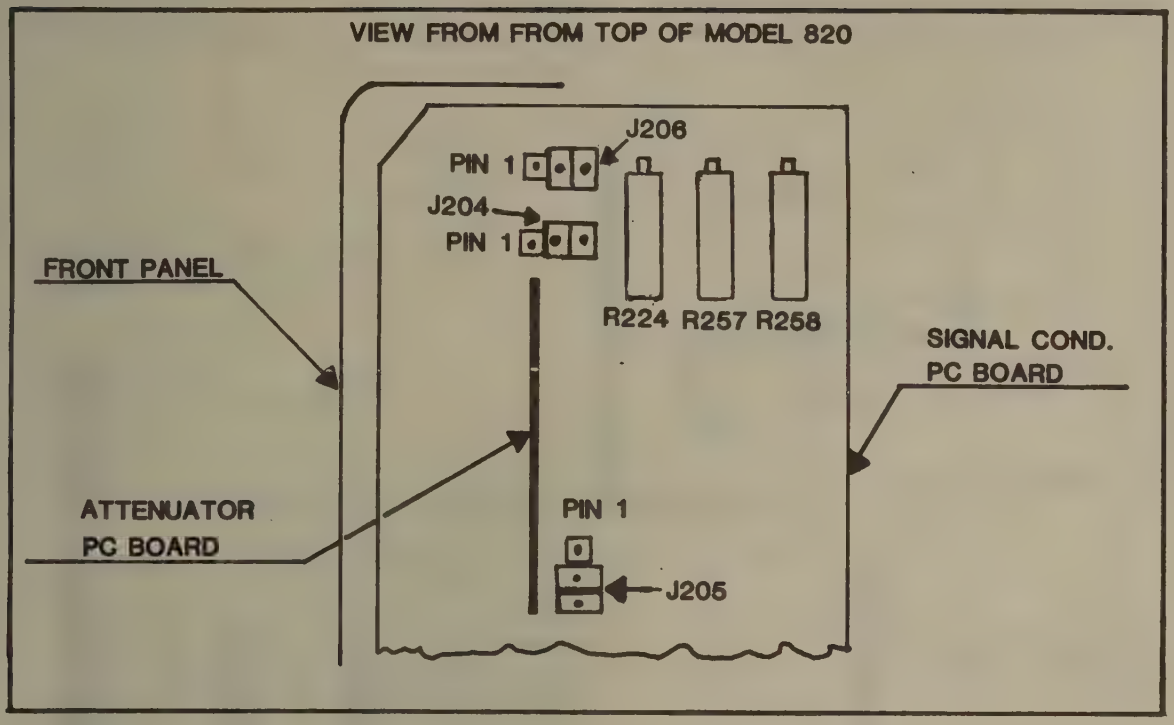


FIGURE 2-2 TEST JUMPER LOCATIONS

c) Set up Test DIP switch for a code of 214 as follows.

DIP Switch Contact Setup - 214 CODE

No.		
	1. OPEN	5. CLOSED
	2. OPEN	6. OPEN
	3. CLOSED	7. OPEN
	4. OPEN	8. CLOSED

d) Connect the DVM, the oscilloscope, and the signal generator to the 820 instrument as shown in Figure 2-3, Page 2-4. The signal generator is connected to the 820 input connector using the 970 input configuration as follows:

(+) SIGNAL - PIN C
GROUND - PINS A and K

The oscilloscope and DVM (-) leads should be connected to the signal generator common.

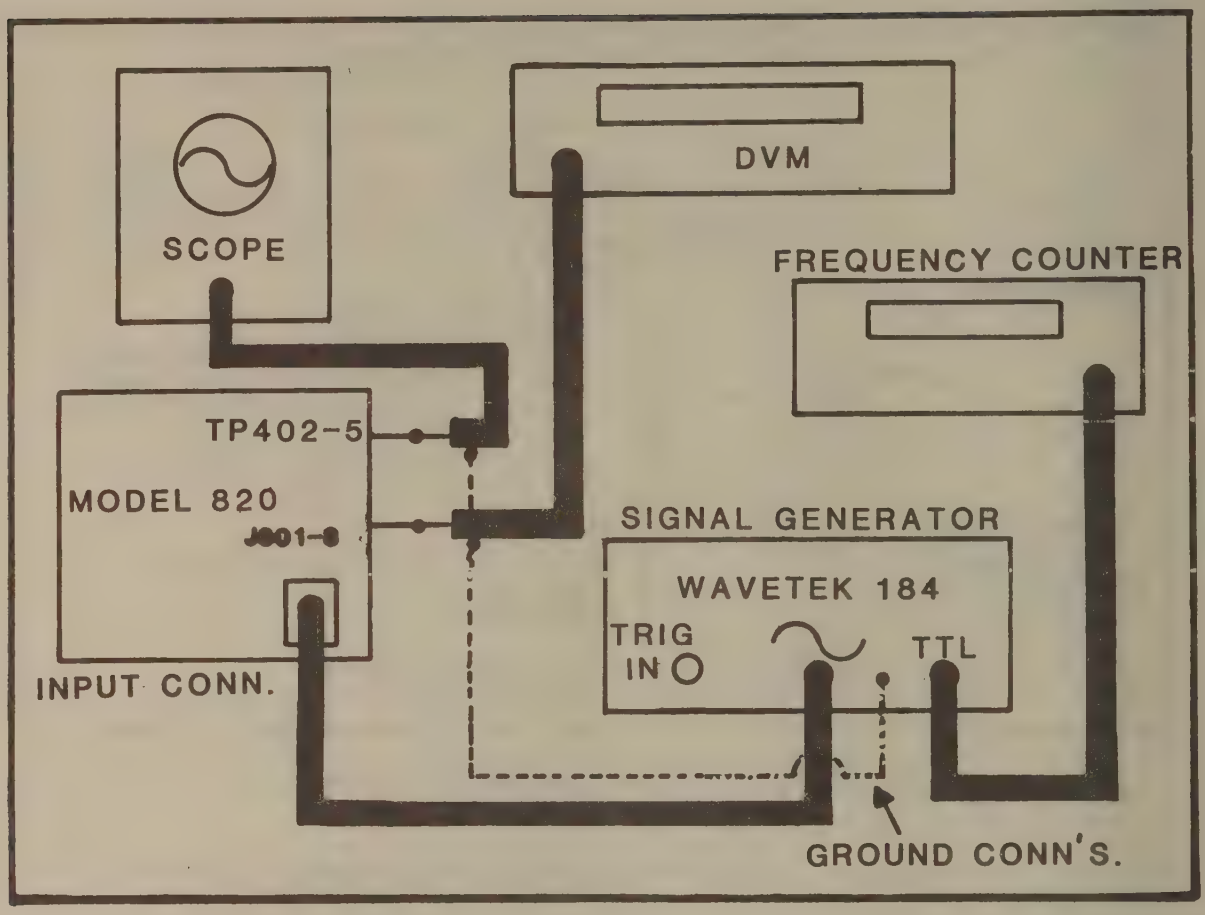


FIGURE 2-3 FILTER CALIBRATION TEST CONNECTIONS

e) Adjust the signal generator for a frequency of 311.19 Hz (3.2135 m sec) and adjust the output amplitude for a DVM reading of 1.00 VDC at J301-3.

NOTE: When adjusting the signal generator amplitude, always disconnect the frequency counter to avoid noise pickup.

f) With the printer operating, connect jumper J206 to Pins 1 and 2 (Fig. 2-2), and adjust R451 for a peak amplitude indication on the oscilloscope. Then, adjust R456 for a DVM reading of 1.000 VDC. Check that the trace being plotted is at the center of the plot scale.

g) Decrease the frequency of the signal generator output so that a reading of 0.707 VDC is obtained on the DVM. Do not change the amplitude of the signal generator output. Record this frequency as f_1.

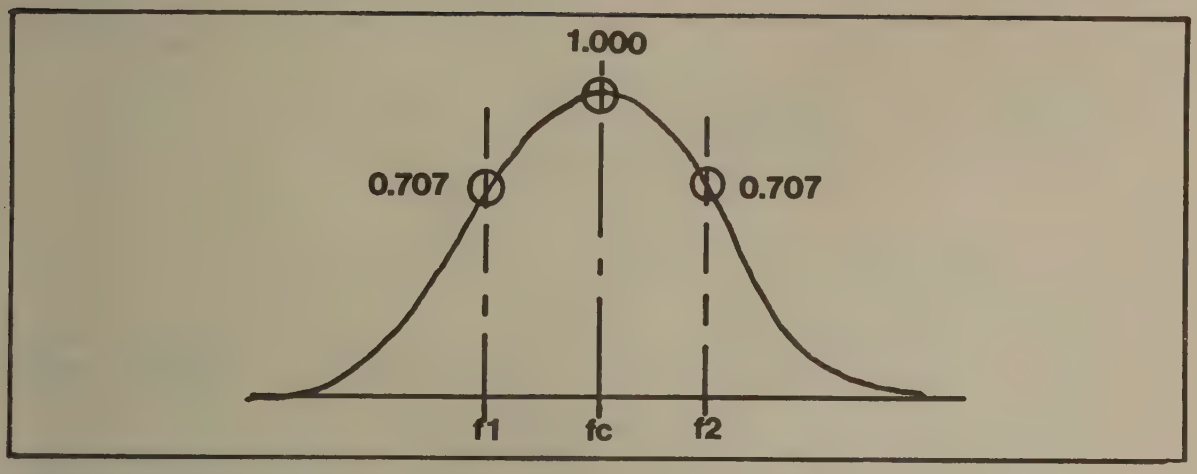


FIGURE 2-4 RELATIONSHIP OF FREQUENCIES f_1 and f_2

h) Increase the frequency of the signal generator output for a DVM reading of 0.707 VDC when tuned beyond the peak. Refer to Figure 2-4. Record this frequency as f_2.

NOTE: The printer can be stopped, if desired, while the calculations are being performed, but it must be operated while Step j) is being completed.

i) From the equation shown below, calculate the value of the quantity Q:

$$Q = \sqrt{f_2 \times f_1} \; / \; (f_2 - f_1)$$

j) Adjust the frequency control of the signal generator for a peak indication on the oscilloscope. Then, readjust R456 so that the DVM reading obtained is equal to the quantity computed by the division Q / 20 VDC. Then, final adjust R467 for a DVM reading of 1.000 VDC.

k) Repeat Steps g) through j) until the value obtained for quantity Q is between 19 and 20.

l) Disconnect jumper J402 to select the "broad" filter mode. J402 is located on the Tach and M-DAC Filter PC Board. Repeat Steps e) through j), but do not change the adjustment of R451. Adjust 460 in place of 456, and adjust R465 in place of R467. In Step j), adjust R460 for a DVM reading equal to Q/10 VDC. The final value of Q must equal 9.5 to 10.5.

m) Adjust the signal generator for an output frequency of 321.35 Hz, (3.1119 m sec), and set up the Test DIP Switch for a code of 216 as follows:

DIP Switch Contact Setup - 216 CODE

No.	1. CLOSED	5. CLOSED
	2. CLOSED	6. OPEN
	3. OPEN	7. OPEN
	4. OPEN	8. CLOSED

Connect jumper J206 to Pins 3 and 2, and adjust the signal generator output amplitude for a DVM reading of 1.000 VDC at J301-3. Reconnect J206 to Pins 1 and 2.

n) Toggle the PLOT/PAUSE switch to stop and restart the printer. Adjust R450 for a peak reading on the oscilloscope. The plotted trace must fall at center scale on the paper.

o) Adjust the signal generator for an output frequency of 10 KHz, and set up the Test DIP Switch for a code of 430 as follows:

DIP Switch Contact Setup - 430 CODE

No.	1. OPEN	5. OPEN
	2. OPEN	6. CLOSED
	3. OPEN	7. OPEN
	4. CLOSED	8. OPEN

Connect jumper J206 to Pins 3 and 2, and adjust the signal generator output amplitude for a DVM reading of 1.000 VDC at J301-3. Reconnect J206 to Pins 1 and 2.

p) Toggle the PLOT/PAUSE switch twice to stop and restart the printer. Carefully adjust the signal generator frequency for a peak reading on the oscilloscope, and adjust C402 for a DVM reading of 1.000 VDC at J301-3.

NOTE: The calibration adjustments for the M-DAC Filter are now completed.

2.3 820 M-DAC FILTER SERVICE GUIDE

The M-DAC Filter used in the Model 820 instrument utilizes many unique features and is an important part of the instrument circuitry. To properly troubleshoot and service the filter, the information provided in this section should be used. The operation of the filter circuit is briefly described, and a troubleshooting chart is provided which lists various circuit function checks.

1. Circuit Description - The M-DAC Filter used in the Model 820 is based on the State-Variable design. A simplified diagram of this circuit is shown in Figure 2-5, Page 2-8. The circuit consists basically of three signal paths or loops. The outer loop shown inside the dotted line enclosure contains two Multiplying Digital to Analog Converters which are controlled in synchronism by the microprocessor. The bandpass center frequency (f_c) is strictly controlled by the two elements designated as K_1 and K_2, the integrator resistors R_1 and R_2, and capacitors C_1 and C_2. The microprocessor tunes the filter through two ranges which are each one and one-half decades in width.

   The Offset Control Path consists of IC-404 output Pins 14 and 1 connected to IC403 input Pin 1. This path compensates for offset errors in the integrators, and ensures a stable, low-offset output. The Q Feedback path is shown by the dashed line and control The Q (bandwidth) of the filter according to the value of the resistor network present in the circuit. If the resistor network were not included in the loop, then the filter circuit would tend to oscillate.

2. Filter Tuning - The equation for the center frequency (f_c) equals:

$$f_c = \frac{K_1 \times K_2}{\sqrt{R_1 R_2 C_1 C_2}} = \frac{K}{\sqrt{R_1 R_2 C_1 C_2}}$$

For a calibrated 820 filter circuit;

$$f_c = K \times B = \frac{d}{4096} \times B$$

Where:

B = 312.2 Hz for the low range and 10 KHz for the high range.

d = the number (decimal) transmitted to the K_1 and K_2 circuits from the microprocessor.

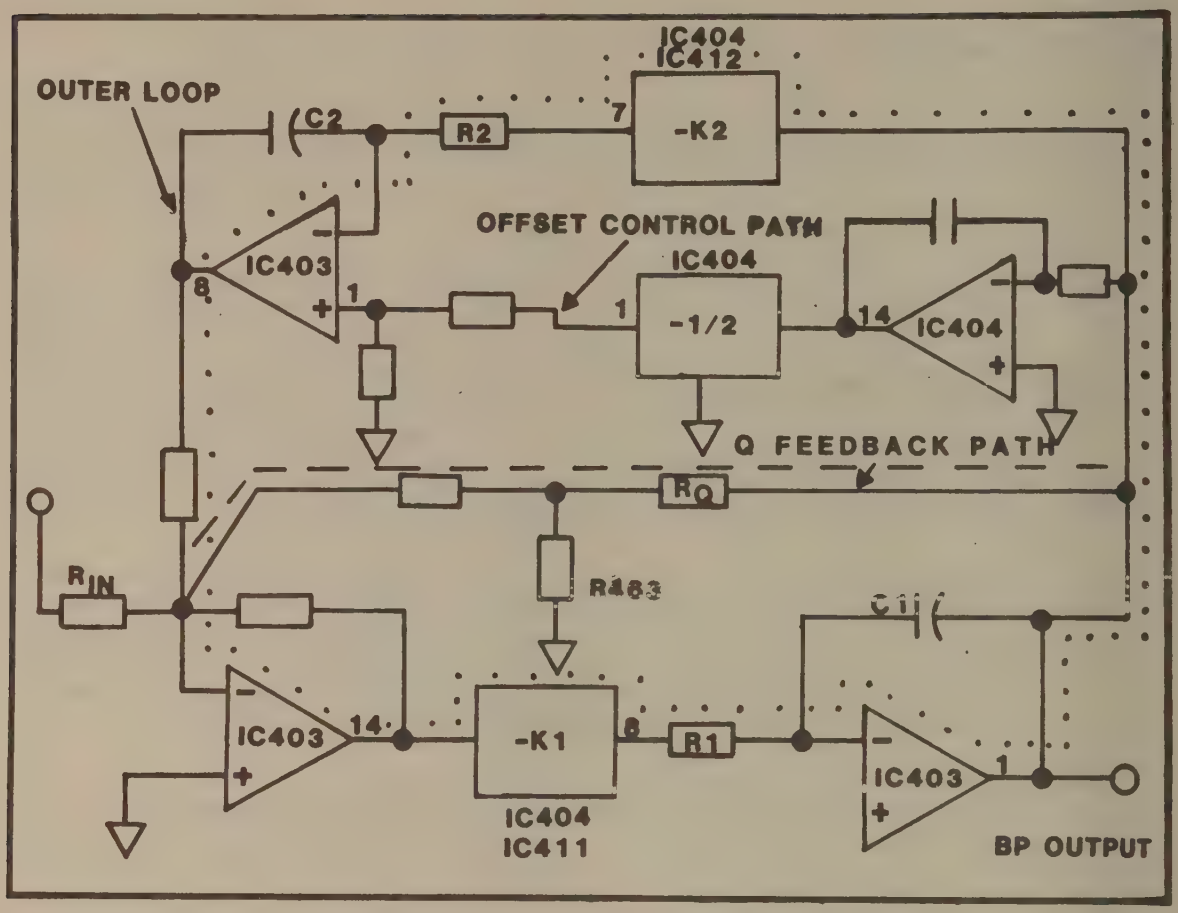


FIGURE 2-5 820 M-DAC FILTER CIRCUIT

In terms of the Test DIP switch setup, the tuned frequency can be represented by

$f_c = (L)^D$ where, $L = 10^{3/430} = 1.0161943$

and, D equals the DIP switch code times 2.

The Test DIP Switch controls the 8 most significant bits of a 9 bit control word. The least significant bit is always zero for any DIP switch setup. The filter can be tuned to any even bin number from 0 through 430, except for the bin numbers used to control the chart setup speeds.

To select any particular frequency, set the AMPLITUDE switch to TEST and the FUNCTION switch to FILTER OUT. Set up the Test DIP switch to the desired bin number code, and press the PLOT/PAUSE switch to PLOT. The microprocessor then tunes the filter to the frequency corresponding to the bin number. A crystal controlled precision square wave signal is produced at the same frequency to which the filter is tuned.

3. Function Checks -

a) If the filter is malfunctioning, verify that the circuit oscillates when R463 is shorted to ground, using short clips. If the circuit does not oscillate, the integrity of the outer loop should be checked.

b) If the filter oscillates by shorting R463 but does not tune properly, the value of all resistors and capacitors located in the outer loop should be verified.

c) If the outer loop circuit is open, Pin 8 of IC403 and/or Pin 1 of IC403 will be at a rail (high or low voltage), depending on the offset voltages present. If either pin is at a rail but the other is not, a defective component (IC) is indicated at the pin that does not have the rail voltage.

d) If the filter output varies with frequency, a defective component in the offset control path is indicated.

e) If the Q of the filter circuit cannot be controlled, then a malfunction in the Q Feedback path is indicated.

NOTE: In this section, the term "rail" is used to indicate that a given amplifier has become saturated, and that the output voltage approximates the plus (+) or minus (-) level of the associated voltage supply. This condition can be caused by the level of the signal input voltage to the amplifier, or by an open-circuited amplifier or associated resistor.

- SERVICE NOTES -

2.4 REPLACEMENT PARTS LISTS AND COMPONENT LOCATION ILLUSTRATIONS

Parts Lists and component layout illustrations of the Model 820 PC Boards are provided on Pages 2-12 through 2-25. The component reference numbers listed on the various Parts Lists and illustrations (R201, C302, etc.) are keyed to the Electrical Schematic Diagrams shown in Section 2.5. The Parts Lists include information for replacement of discrete components on the PC Boards or for replacement of the entire PC Board. Table 2-1, which follows, is a listing of the general instrument components.

TABLE 2-1 820 GENERAL PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
---	Meter, Amplitude	24069
---	Printer Assembly	26242
---	Receptacle, Tach Input 5 Pin Female	24204
---	Receptacle, Pickup Input Amphenol 9 Pin	19647
SW202	Switch, Amplitude	23992
SW201	Switch, Units 4 Position	23993
SW203	Switch, Function 5 Position	23994
---	Switch, Plot-Adv/Pause Toggle, w/harness	24709
---	Switch, Power, and Charger/Tach Input, w/harness	24707
---	LED Indicator, Red	21335
---	Switch, PLOT Speed, w/harness	27697
---	Switch, Power Interlock, w/harness	27694

TABLE 2-2 POWER SUPPLY PC BOARD ASSEMBLY
PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
---	Power Supply PC Board Assembly	24085
C101,102,104	Capacitor, 220 UF, 16V	24928
C103,105,106, 107,110,111, 113,114,115	Capacitor, .1 UF, 50V Ceramic	17143
C108	Capacitor, 47 UF, 35V, Tantalum	12528
C109	Capacitor, .001 UF, 200V, 10%	5039
C112,116	Capacitor, 500 UF, 25V	5324
C117,118	Capacitor, .01 UF, 50V Ceramic	22030
C119,120	Capacitor, 4.7 UF, 35V Tantalum	13701
C121,122	Capacitor, 1 UF, 35V Tantalum	13594
CR101	Semiconductor, Diode 1N4003, 200V	5948
CR102	Semiconductor, Diode VSK130, 30V	19312
CR103	Semiconductor, Diode VSK140, 40V	19232
IC101	IC, Lin. Amp. TL062CP	20393
IC102	IC, Regulator, MC 1403U	17407
IC103,104	IC, Regulator, TL494CN	19306
IC105	IC, Regulator, SG3501AJ, ±15V	24704
J101	Header, 11 Pin, .156 Centers	24567
J102	Header, 5 Pin, .156 Centers	20220
L101,102	Inductor, 2 MH, ±10%	19313
Q101	Semiconductor, Transistor, D45H11AP PNP	23703
Q102	Semiconductor, Transistor, 2N3643 NPN	13458
Q103	Semiconductor, Transistor, D40C1 HSH NPN	19310
Q104	Semiconductor, Transistor, D41K2 HSH PNP	19311
R101,109	Resistor, 150 K, 1/8 W, Metal Film, 1%	7869
R102	Resistor, 1.1 K, 1/8 W, Metal Film, 1%	10085
R103	Resistor, 301 Ohm, 1/8 W, Metal Film, +1%	9539
R104,106	Resistor, 2.15 K, 1/8 W, Metal Film, 1%	7851
R105	Potentiometer, 1K, .5W, 10%, 25 Turns	14037
R107,122	Resistor, 28 K, 1/8 W, Metal Film, 1%	9585
R108	Resistor, 24.3 K, 1/8 W, Metal Film, 1%	9715
R110,112	Resistor, 10 K, 1/8 W, Metal Film, 1%	7859
R111	Resistor, 68.1 K, 1/8 W, Metal Film, 1%	7867
R113	Resistor, 78.7 K, 1/8 W, Metal Film, 1%	7687
R114	Resistor, 30.1 K, 1/8 W, Metal Film, 1%	10064
R115	Resistor, 499 Ohm, 1/8 W, Metal Film, 1%	7975
R116	Resistor, 20 K, 1/8 W, Metal Film, 1%	9274
R117	Resistor, 1 Meg, 1/8 W, Carbon Film, 1%	9267
R118	Resistor, 24.9 K, 1/8 W, Metal Film, 1%	12880
R119	Resistor, 4.99 K, 1/8 W, Metal Film, +1%	9105
R120	Resistor, 2.21 K, 1/8 W, Metal Film, 1%	7852
R121,127,129	Resistor, 200 K, 1/8 W, Metal Film, 1%	14000
R123,126	Resistor, 3.3 Ohm, 1/2 W, Wirewound, 1%	5881
R124	Resistor, 40.2 Ohm, 1/8 W, Metal Film, 1%	13252
R128,130	Potentiometer, 100 K, .5 W 10%, 25 Turns	13886
R131	Resistor, 499 K, 1/8 W, Metal Film, 1%	9188

TABLE 2-2 POWER SUPPLY PC PARTS LIST (Continued)

REF. NO.	DESCRIPTION OF PART	PART NO.
R132	Resistor, 261 K, 1/8 W, Metal Film, 1%	9806
TP101	Test Jack, Orange	15616
TP102	Test Jack, Green	15615
TP103	Test Jack, Blue	15619

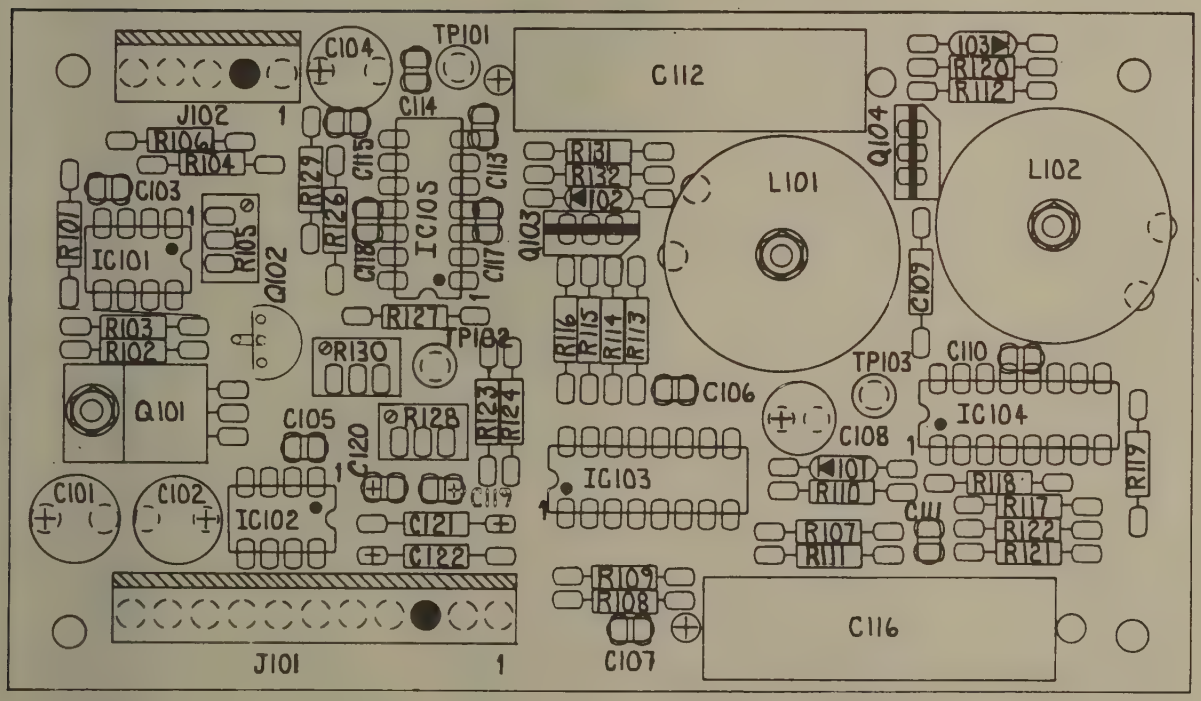


FIGURE 2-6 POWER SUPPLY PC BOARD COMPONENT LOCATIONS

TABLE 2-3 SIGNAL CONDITIONER PC BOARD ASSEMBLY PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Signal Conditioner PC Board Assembly	27693
C201	Capacitor, 10 PF, 500V, Mica	7835
C202,203,208, 210,211,212, 214,215,221, 230,231,235,236	Capacitor, .1 UF, 50V, Ceramic	17143
C204	Capacitor, .22 UF, 100V	19639
C205,218	Capacitor, .1 UF, 100V	19638
C206	Capacitor, .033 UF, 250V	22125
C207	Capacitor, 270 PF, 500V, Mica	9882
C209	Capacitor, 5 UF, 25V, Non-Pol.	5029
C213	Capacitor, .47 UF, 100V	20055
C216,233,234	Capacitor, 1 UF, 50V, Ceramic	20930
C217,226,229	Capacitor, .01 UF, 400V	22121
C219	Capacitor, 25 UF, 12V Non-Pol.	5464
C220,222,223	Capacitor, 2.2 UF, 16V, Tantalum	20704
C224,225	Capacitor, .001 UF, 80V	9632
C227,228	Capacitor, 3.3 UF, 25V, Tantalum	5395
C232	Capacitor, 500 UF, 3V	3531
C237	Capacitor, 5 pF 500V	1471
CR201,202	Semiconductor, Diode HCD	7831
CR203	Semiconductor, Diode 1N4003, 200V	5948
IC202,203	IC, Lin. Amp. TL061 TP/ACP/IJG	19518
IC204,208,201,207	IC, Lin. Amp. TL062 IP/ACP	19519
IC205	IC, Lin. Amp. NE555V Timer	14918
IC206	IC, Module AD536J	17480
IC209,210	Semiconductor, Transistor, D-MOS FET Switch, N.C.	20402
J201	Header, 9 Pin, .100 Centers	24395
J202	Header, 34 Pin	20180
J203	Header, 3 Pin, .100 Centers	20910
J204,205,206	Header, 3 Pin, .100 Centers	13033
Q201	Semiconductor, Transistor D39C3 PNP	16526
Q202	Semiconductor, Transistor D38L3 NPN	15469
Q203	Semiconductor, Transistor 2N5089 NPN	13460
R225,234,236	Resistor, 1K, 1/8 W, Metal Film, 1%	7848
R201	Potentiometer, 500 K, Cermet, 89W	9276
R202	Resistor, 1.65 Meg, 1/8 W, Metal Film, 1%	21002
R203	Resistor, 102K, 1/8 W, Metal Film, 1%	19630
R205,208	Resistor, 464K, 1/8 W, Metal Film, 1%	20087
R206	Resistor, 76.8K, 1/8 W, Metal Film, 1%	19656
R207,208	Resistor, 383K, 1/8 W, Metal Film, 1%	19659
R209	Potentiometer, 5K Cermet, 89W	8337

(Table 2-3 continued on Page 2-16)

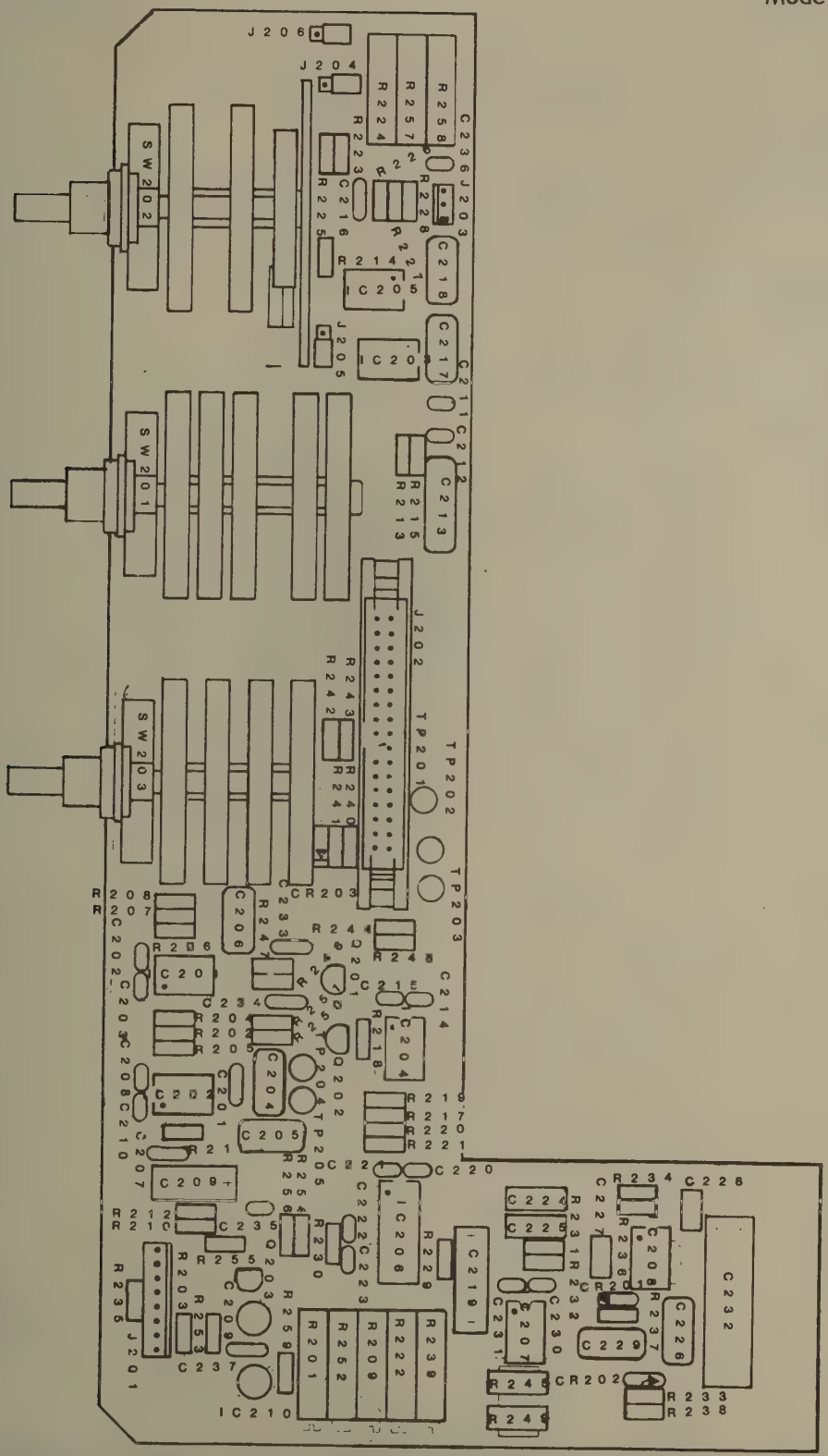


FIGURE 2-7 SIGNAL CONDITIONER PC BOARD COMPONENT LOCATIONS

TABLE 2-3 SIGNAL CONDITIONER PC BOARD
ASSEMBLY PARTS LIST (Continued)

REF. NO.	DESCRIPTION OF PART	PART NO.
R210	Resistor, 8.06K, 1/8 W, Metal Film, 1%	10079
R211	Resistor, 9.09K, 1/8 W, Metal Film, 1%	9588
R212,214,217, 223,229,235,237	Resistor, 3.01 Meg, 1/8 W, Metal Film, 1%	14018
R213	Resistor, 22.1K, 1/8 W, Metal Film, 1%	7863
R215	Resistor, 2.87K, 1/8 W, Metal Film, 1%	15433
R218	Resistor, 90.9K, 1/8 W, Metal Film, 1%	8440
R219,220,226 246,250	Resistor, 10K, 1/8 W, Metal Film, 1%	7859
R221	Resistor, 82.5K, 1/8 W, Metal Film, 1%	8106
R222	Potentiometer, 20K, Cermet 89W	5476
R224	Potentiometer, 200 Ohm, Cermet 89W	14193
R227	Resistor, 13K, 1/8 W, Metal Film, 1%	10071
R228	Resistor, 301K, 1/8 W, Metal Film, 1%	9283
R230	Resistor, 24.3K, 1/8 W, Metal Film,1%	9715
R231	Resistor, 22.6K, 1/8 W, Metal Film,1%	16194
R232	Resistor, 45.3K, 1/8 W, Metal Film,1%	13992
R233	Resistor, 32.4K, 1/8 W, Metal Film,1%	9273
R238	Resistor, 5.76K, 1/8 W, Metal Film,1%	17576
R239	Potentiometer, 5K, Cermet, 89 W	8337
R240	Resistor, 3.74K, 1/8 W, Metal Film,1%	10250
R241	Resistor, 432 Ohm, 1/8 W, Metal Film, 1%	9541
R242	Resistor, 39.2K, 1/8 W, Metal Film,1%	13569
R243	Resistor, 93.1K, 1/8 W, Metal Film,1%	8589
R244,248	Resistor, 100 Ohm, 1/8 W, Metal Film, 1%	7843
R245,249	Potentiometer, 180 Ohm, 1.5 W, Ceramic, 5%	11681
R247,251	Resistor, 8.06 Meg, 1/8 W, Metal Film, 1%	20996
R252	Potentiometer, 1 Meg, Cermet 89W	12348
R253	Resistor, 1.91 Meg, 1/8 Metal Film,1%	20995
R254,255,256,259	Resistor, 100K, 1/8 W, Metal Film, 1%	7868
R257	Potentiometer, 100K, 3/4 W, Cermet	8339
R258	Potentiometer, 500 Ohm, 3/4 W, Cermet	7884
R261	Resistor, 18.2K, 1/8 W, Metal Film, 1%	7881
SW201	4 Position Switch - Units	23993
SW202	Attenuator Switch Assm.	24079
SW203	5 Position Switch - Function	23994
TP201	Test Jack, White	15612
TP202,205	Test Jack, Yellow	15617
TP203,204	Test Jack, Orange	15616
---	Cable, Assm. Shielded	25281
---	Cable, Shielded	25280

TABLE 2-4 A/D AND INTERCONNECT PC BOARD ASSEMBLY PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	A/D and Interconnect PC Board Assembly	25088
C301,302,303, 306,307,308, 309,310,311, 312,313,314	Capacitor, 1 UF, 50V, Ceramic	17143
C304	Capacitor, 100 PF, 500V, Mica	7837
C305	Capacitor, 4.7 UF, 35V, Tantalum	13701
IC301	IC, Digital, 4011BCP	19617
IC302	IC, Digital, 4027BCP	20089
IC303	IC, Digital, MC14051BCP	23521
IC309	IC, Module, AD7574JN	23523
IC310	IC, Regulator, UA79M05AHC	19309
IC311	IC, Lin. Amp., TL062CP Dual Op Amp	20393
J301	Header, 3 Pin, .100 Center	13198
R301,302	Resistor, 100K, 1/8 W, Metal Film, 1%	7868
R303	Resistor, 1 Meg, 8 Pin, 2% SIP	19642
R304	Resistor, 1K, 1/8 W, Metal Film, 1%	7848
R305	Resistor, 178K, 1/8 W, Metal Film, 1%	9442
R306	Resistor, 56.2K, 1/8 W, Metal Film, 1%	13570
R307,309,312	Resistor, 10K, 1/8 W, Metal Film, 1%	7859
R308	Resistor, 1 Meg, 1/8 W, Carbon Film, 1%	9267
R310	Potentiometer, 10K, 89W	5579
R311	Resistor, 2.94K, 1/8 W, Metal Film,1 %	12493
R313	Resistor, 60.4K, 1/8 W, Metal Film, 1%	14490
R314	Potentiometer, 100K, 89W	8339
R315	Resistor, 40.2K, 1/8 W, Metal Film, 1%	8675
TP301	Test Jack, Yellow	15617
TP302	Test Jack, Black	15614

TABLE 2-5 TACHOMETER AND M-DAC FILTER PC BOARD ASSEMBLY PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Tach and M-DAC Filter PC Board Assembly	25085
C401	Capacitor, 56 PF, 500V, Mica	13580
C402	Capacitor, 5.5-18 PF Variable Ceramic	25744
C403,407	Capacitor, 1000 PF, 200V, COG, Cer	26176
C404,418	Capacitor, 20 PF, 500V, Mica	13579
C405,408,409,410, 411,413,419,420, 421,422,427	Capacitor, .1 UF, 50V, Ceramic	17143
C406	Capacitor, 2 UF, 50V	13880
C412,417	Capacitor, .22 UF, 100V	19639

(Table 2-5 continued on Page 2-19)

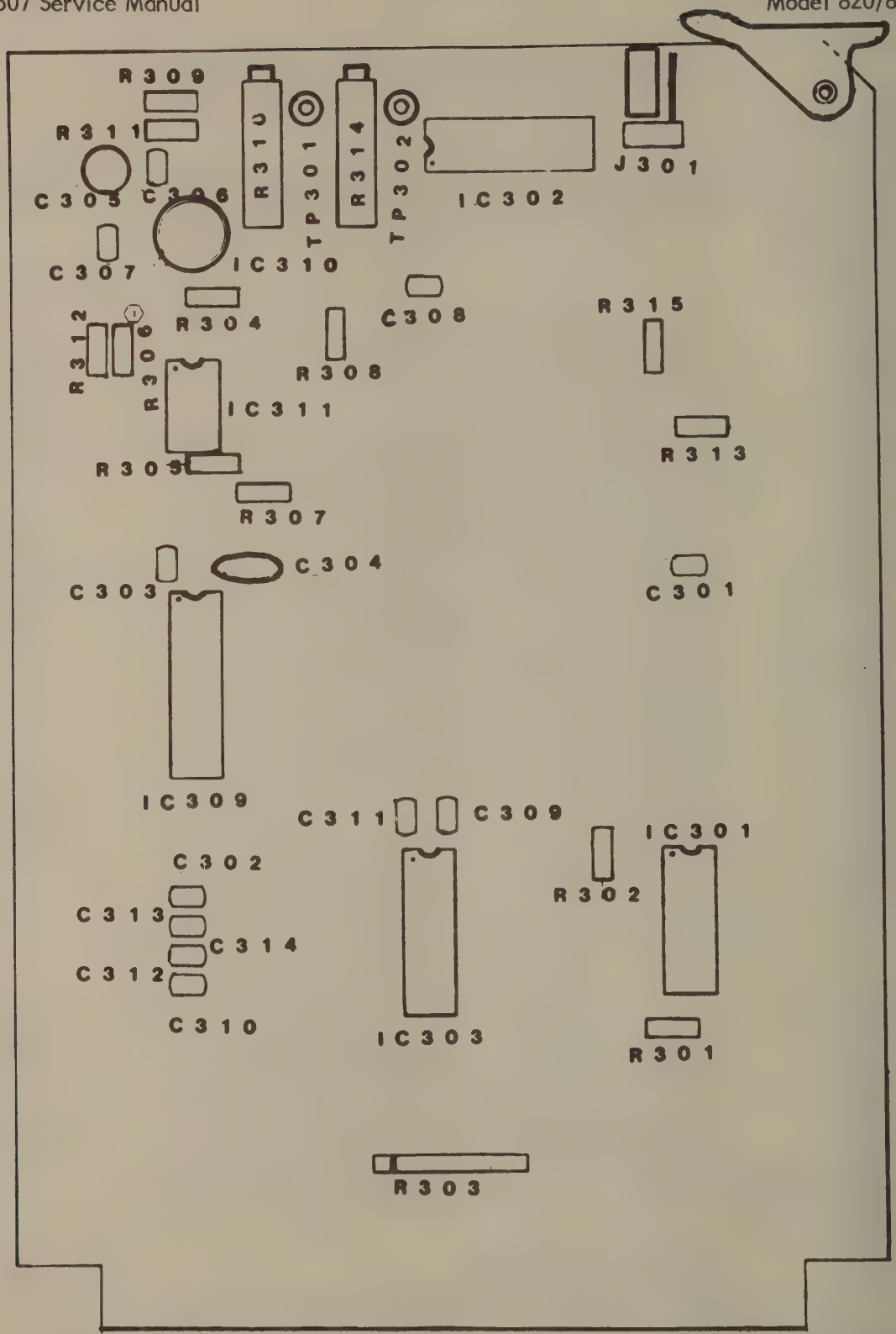


FIGURE 2-8 A/D AND INTERCONNECT PC BOARD COMPONENT LOCATIONS

TABLE 2-5 TACHOMETER AND M-DAC FILTER PC BOARD ASSEMBLY PARTS LIST (Continued)

REF. NO.	DESCRIPTION OF PART	PART NO.
C414	Capacitor, 3 UF, 100V, MYLAR	9002
C415	Capacitor, .1 UF, 100V	19638
C416	Capacitor, 1 UF, 50V	20474
C425	Capacitor, 200 PF, 500V, Mica	9881
CR401,402	Semiconductor, Diode, 1N52708, 91V	9218
CR403,405	Semiconductor, Diode, 1N5283, .22 MA	9217
CR404,406	Semiconductor, Diode, 1N67A, 80V	1380
CR407,408	Semiconductor, Zener, 1N5229B, 4.3V	13452
CR409,410,411	Semiconductor, Diode, 1N914A	5398
IC401,402	IC, Lin. Amp. AD7512D1JN	24929
IC403,404	IC, Lin. Amp. TL074CN	22445
IC405,406	IC, Lin. Amp., TL072CP	22444
IC407	IC, Lin. Amp. CA3140AS	14993
IC408	IC, Digital, 4027BCP	20089
IC409	IC, Digital, 4047BE	24143
IC410	IC, Digital, MC14051BCP	23521
IC411,412	IC, Module, AD7542JN	25083
J402	Header, 3 Pin, .100 Centers	13033
Q401	Semiconductor, Transistor, 2N3568, NPN	4583
R413,414,435	Resistor, 1 Meg Resistor Pack, 6 Pin, 2%	19640
R415,423	Resistor, 124K, 1/8 W, Metal Film, 1%	19629
R416,440,443, 448,458,462	Resistor, 20K, 1/8 W, Metal Film, 1%	9274
R417	Resistor, 6.04K, 1/8 W, Metal Film, 1%	10077
R418	Resistor, 1.87K, 1/8 W, Metal Film, 1%	17581
R419	Resistor, 100 Ohm, 1/8 W, Metal Film, 1%	7843
R420,421,422	Resistor, 63.4K, 1/8 W, Metal Film, 1%	14036
R425,441,457 459,461	Resistor, 10.5K, 1/8 W, Metal Film, 1%	12288
R424,432,438,447	Resistor, 10K, 1/8 W, Metal Film, 1%	7859
R426,427,453,469	Resistor, 475K, 1/8 W, Metal Film, 1%	7871
R428	Resistor, 47.5K, 1/8 W, Metal Film, 1%	7866
R429	Resistor, 49.9K, 1/8 W, Metal Film, 1%	10054
R430,449	Resistor, 2.2 Meg, 1/8 W, Carbon Film, 1%	9298
R431	Resistor, 499 Ohm, 1/8 W, Metal Film, 1%	7975
R433	Resistor, 1 Meg, 1/8 W, Carbon Film, 1%	9267
R434	Resistor, 1 Meg, Resistor Pack, 8 Pin, 2%	19642
R439	Resistor, 274 Ohm, 1/8 W, Metal Film, 1%	9538
R442,454	Resistor, 4.99K, 1/8 W, Metal Film, 1%	9105
R445	Resistor, 10 Ohm, 1/8 W, Metal Film, 1%	7840
R446	Resistor, 2.21K, 1/8 W, Metal Film, 1%	7852
R450,456,460,465	Potentiometer, 50 K, 3/4 W, 10%	8338
R451,467	Potentiometer, 100K, 3/4 W, 10%	8339
R452	Resistor, 5.11K, 1/8 W, Metal Film,1%	9137
R455	Resistor, 34.8K, 1/8 W, Metal Film,1%	23166
R463	Resistor, 3.92K, 1/8 W, Metal Film,1%	9860

(Table 2-5 continued on Page 2-20)

TABLE 2-5 TACHOMETER AND M-DAC FILTER PC BOARD ASSEMBLY PARTS LIST (Continued)

REF. NO.	DESCRIPTION OF PART	PART NO.
R466	Resistor, 7.15K, 1/8 W, Metal Film, 1%	9297
R468	Resistor, 14K, 1/8 W, Metal Film, 1%	10072
TP401	Header, 8 Pin, .100 Centers	13035
TP402	Header, 7 Pin, .100 Centers	13202

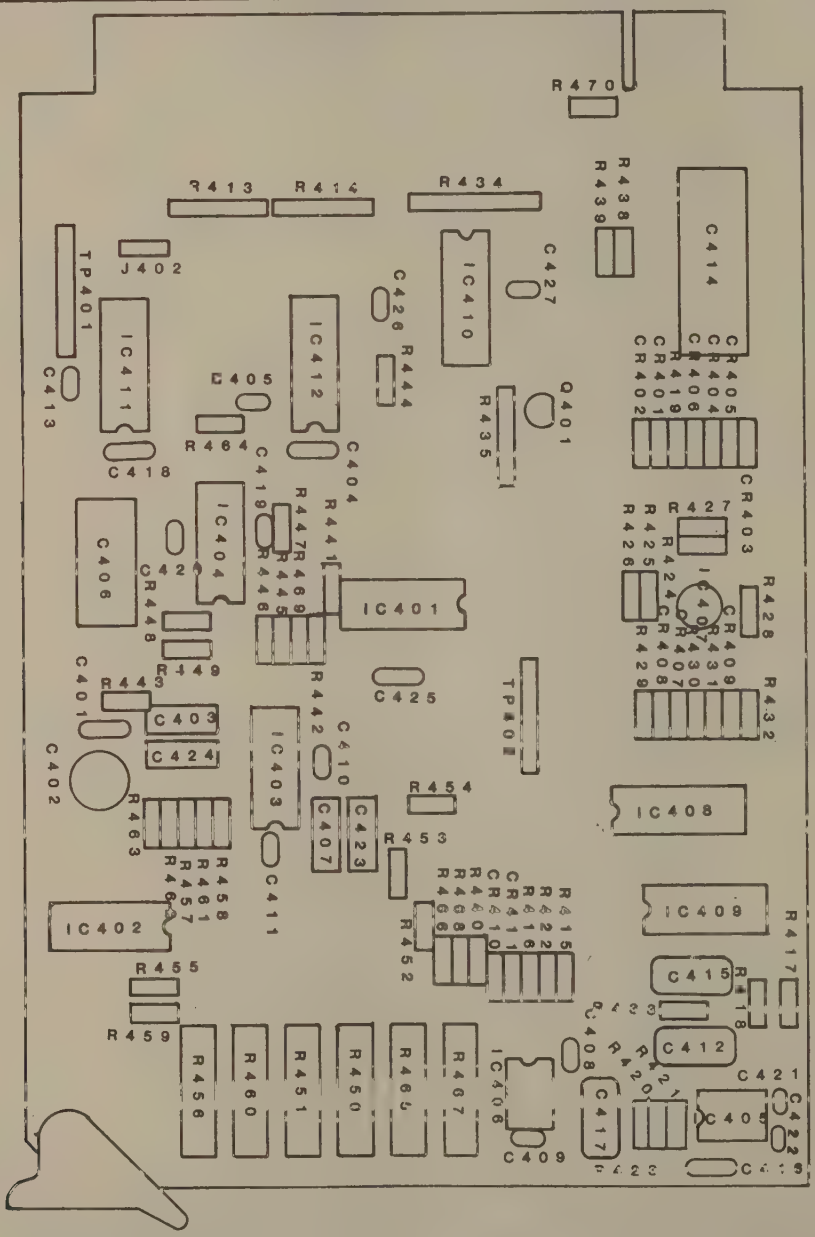


FIGURE 2-9 TACHOMETER AND M-DAC FILTER PC BOARD COMPONENT LOCATIONS

TABLE 2-6 ATTENUATOR PC BOARD ASSEMBLY
PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Attenuator PC Board Assembly	24079
J501	Header, 4 Pos., .100 CTR RT Ang.	11411
R501	Resistor, 31.6 Ohm, 1/8 W, MF, 1%	7841
R502	Resistor, 68.1 Ohm, 1/8 W, MF, 1%	7842
R503	Resistor, 215 Ohm, 1/8 W, MF, 1%	7844
R504	Resistor, 681 Ohm, 1/8 W, MF, 1%	7846
R505	Resistor, 2.15K, 1/8 W, MF, 1%	7851
R506	Resistor, 6.81K, 1/8 W, MF, 1%	7857
R507	Resistor, 21.5K, 1/8 W, MF, 1%	7862
R508	Resistor, 68.1K, 1/8 W, MF, 1%	7867
-----	Switch, 820 Amplitude	23992

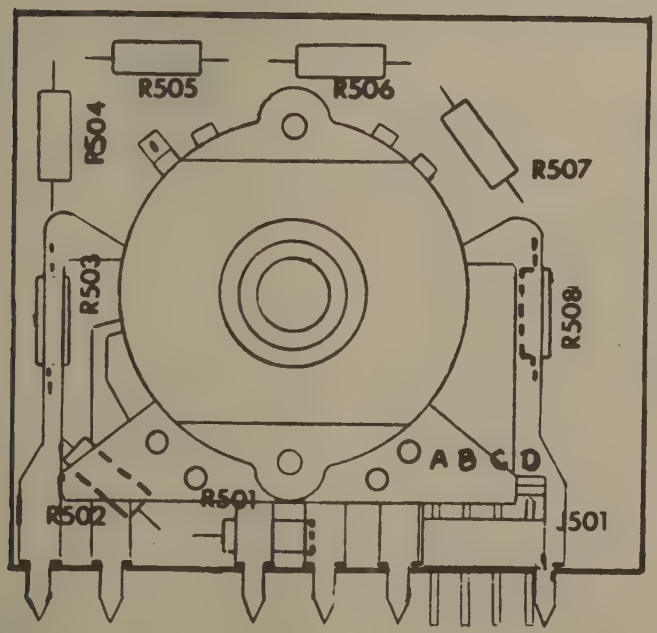


FIGURE 2-10 ATTENUATOR PC BOARD COMPONENT LOCATIONS

TABLE 2-7 FUSE PC BOARD ASSEMBLY
PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Fuse PC Board Assembly	27700
F601	Fuse, 1-1/2 A, 3AG, Slo-Blo	1508
F602	Fuse, 2A, 3AG, Slo-Blo	20138
IC601	IC, Digital, MC14512B	27732
IC602	SC/Diode Array, CA3141E	27731
J601	Header, 9 Pin, .100 Centers	24395
J602	Header, 11 Pin, .156 Centers	24567
J603	Header, 4 Pin, .156 Centers	20219
J604	Header, 5 Pin, .156 Centers	20220
J605	Header, 6 Pin, .156 Centers	20288
J606	Header, 3 Pin, .100 Centers	20910
J607	Header, 7 Pin, .156 Centers	24278
J608	Header, 10 Pin, .100 Centers	26172
J609	Header, 4 Pin, .100 Centers	20578
R601,602	Resistor, SIP 10K, 2% 5 Res.	21632

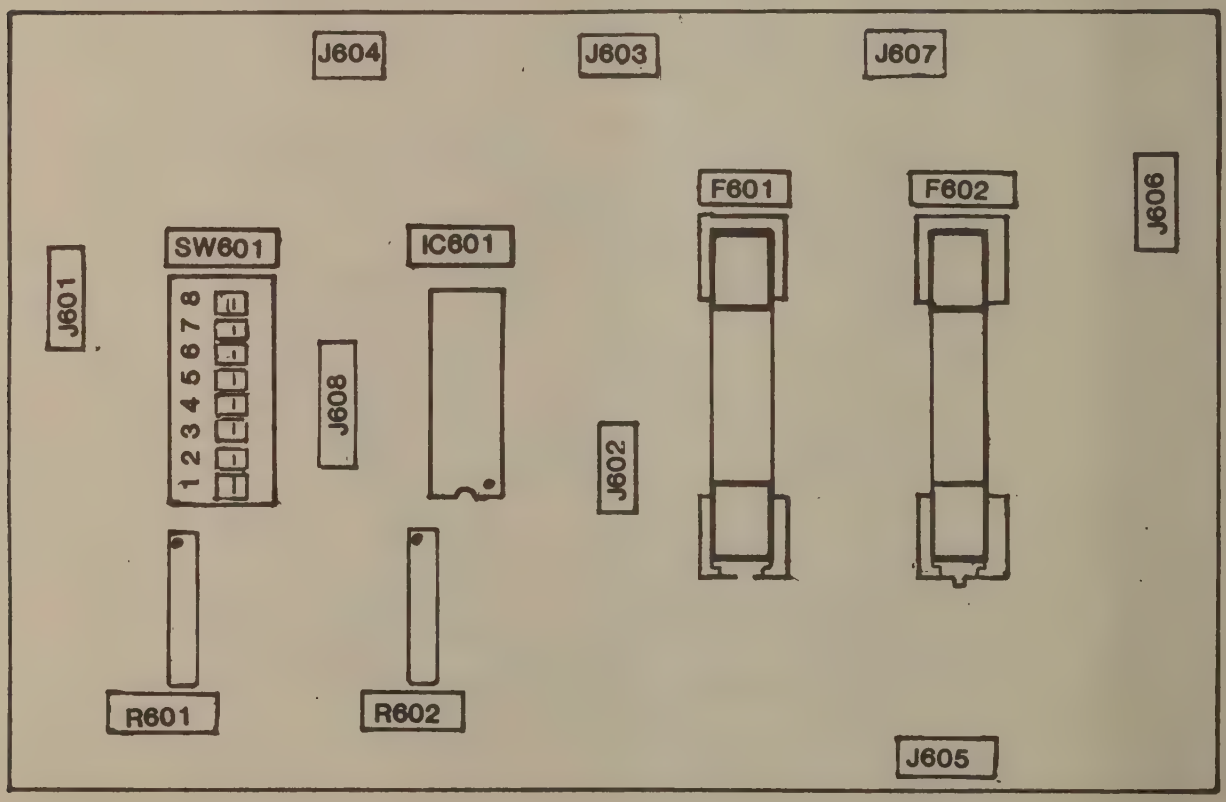


FIGURE 2-11 FUSE PC BOARD COMPONENT LOCATIONS

TABLE 2-8 MOTHER PC BOARD ASSEMBLY
PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Mother PC Board Assembly	25355
J701	Header, 5 Pin, .100 Centers	20911
J702	Header, 12 Pin, .100 Centers	24638
J703	Header, 9 Pin, .100 Centers	24395
J704,705,706	Connector, 29 Pin Dual Cont.	23710
J707	Header, 34 Pin Right Angle	23708
J708	Header, 2 Pin Right Angle, .100 Centers	25335
J709	Header, 8 Pin, .156 Centers	20227

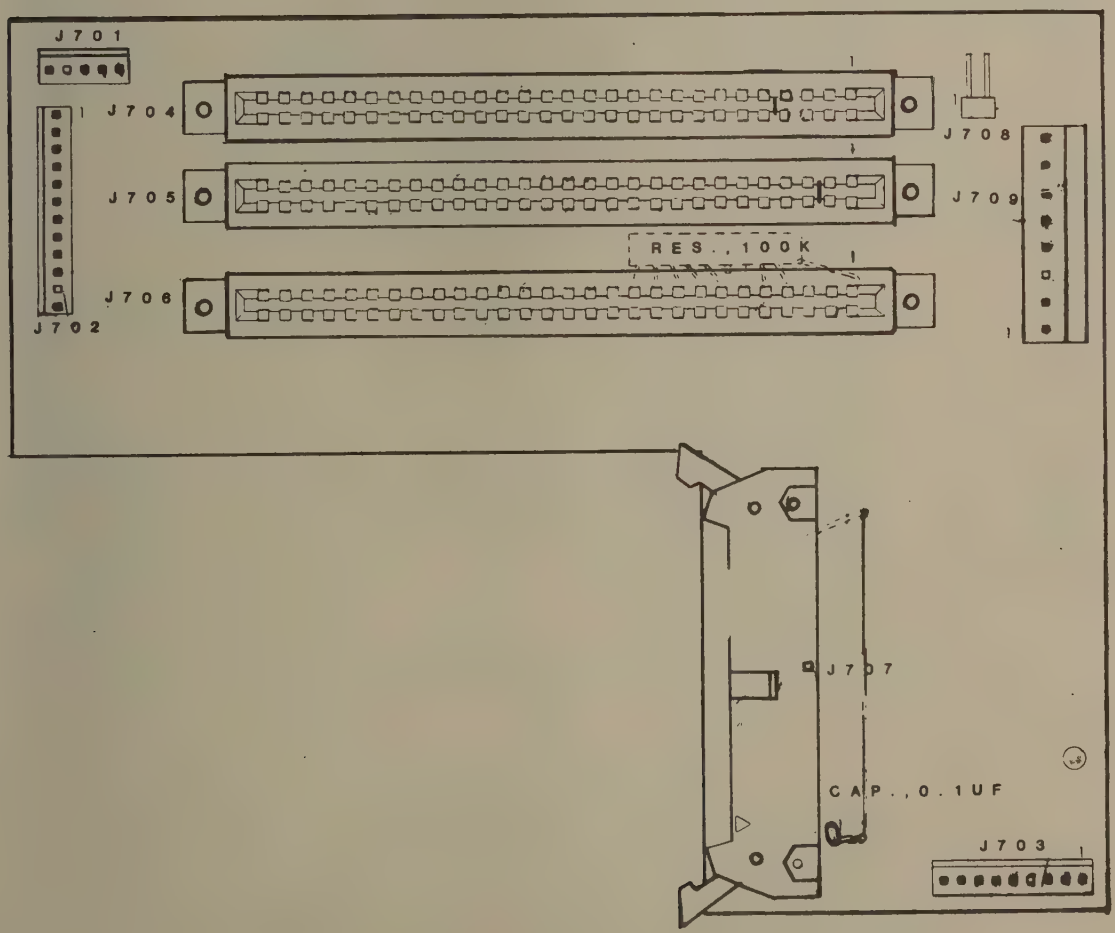


FIGURE 2-12 MOTHER PC BOARD COMPONENT LOCATIONS

TABLE 2-9 MICROPROCESSOR AND
MAIN MEMORY PC BOARD ASSEMBLY PARTS LIST

REF. NO.	DESCRIPTION OF PART	PART NO.
-----	Microprocessor and Main Memory PC Board Assembly	27699
C701,704	Capacitor, 1 MF, 50V	27386
C702	Capacitor, 6.8 MF, 20V Tant.	5396
C703,705	Capacitor, .01 MF, 100V Cer.	20265
C706	Capacitor, .1 MF, 100V Cer.	15205
D701,703,702, 704,705,706	Semiconductor, Diode 1N914A	5398
D707	Semiconductor, Zener, 1N5252A, 24V	8553
J701	Header, 6 Pin, .156 Center, Rt. Angl.	26888
J702	Header, 6 Pin, .100 Center, Rt. Angl.	26887
J703	Header, 34 Pin, Rt. Angl., w/short eject	27867
Q701,702,703, 704,705	Semiconductor, Transistor, PNP 2N5195	26892
Q706	Semiconductor, Transistor, NPN 2N3904	26891
R701	Resistor, 47.5K, 1/8 W, MF, 1%	7866
R702,703,712,715	Resistor, 10K, 1/8 W, MF, 1%	7859
R704	Resistor, 2.21K, 1/8 W, MF, 1%	7852
R705,711,721	Resistor, 1K, 1/8 W, MF, 1%	7848
R706,707,708 709,710,716 thru 720	Resistor, 100 Ohm, 1/8 W, MF	7843
R713	Resistor, 10 Ohm, 1/8 W, MF	7840
R714	Resistor, 27.4K, 1/8 W, MF	7864
R722	Resistor, SIP, 100K	26241
S701	Switch, DIP, 3 Pos., On-Off	26893
U701	IC, Digital, P8255A	23137
U702	IC, Digital, P8156H-2	26885
U703	IC, Digital, P8085A	23135
U704	IC, Digital, 8755A Prog #2 EPROM	29618
U705	IC, Digital, 8755A Prog #1 EPROM	27729
U706,707,708, 709,710	IC, Digital, ULN 2003A	23143
Y701	Crystal, 6.000 MHz	26886

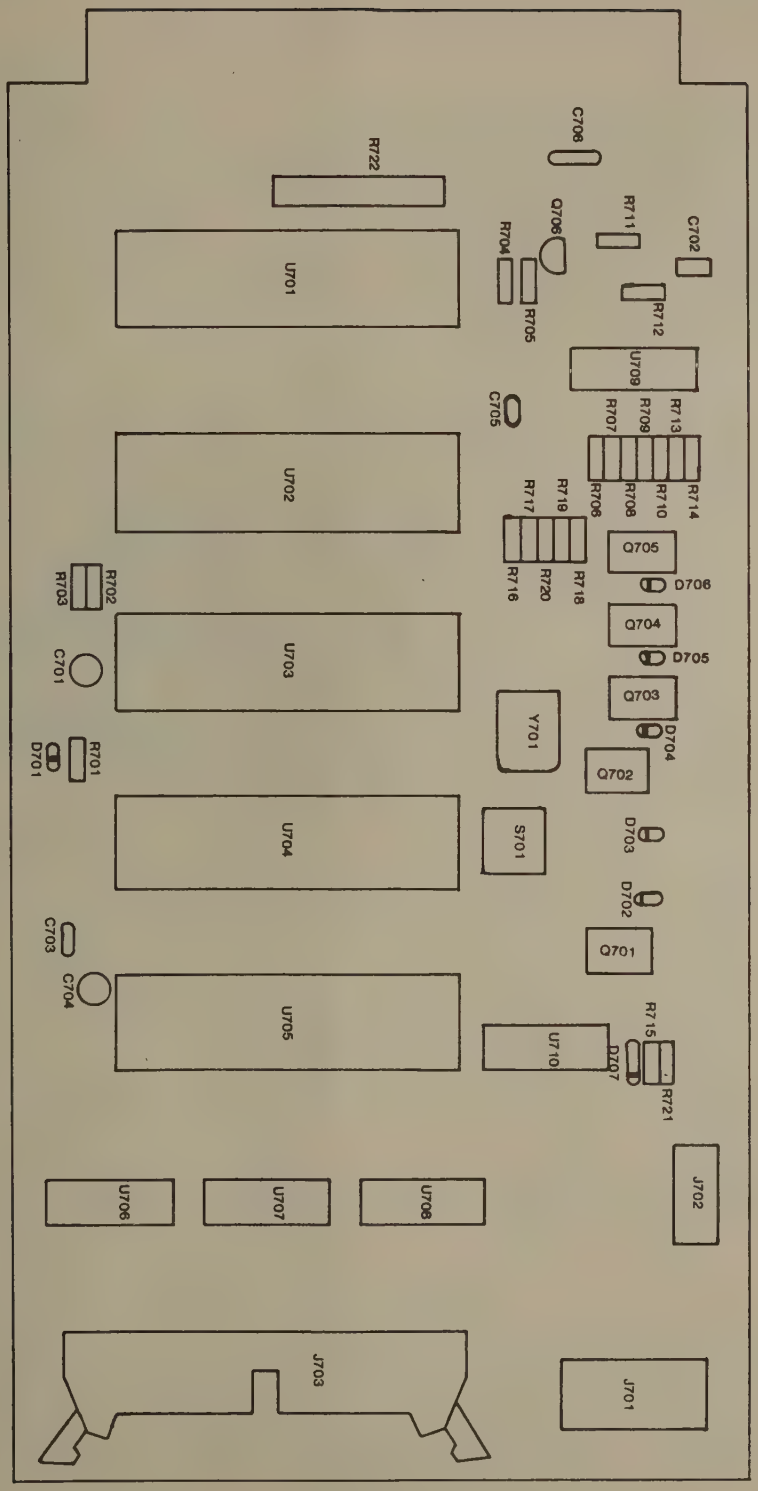
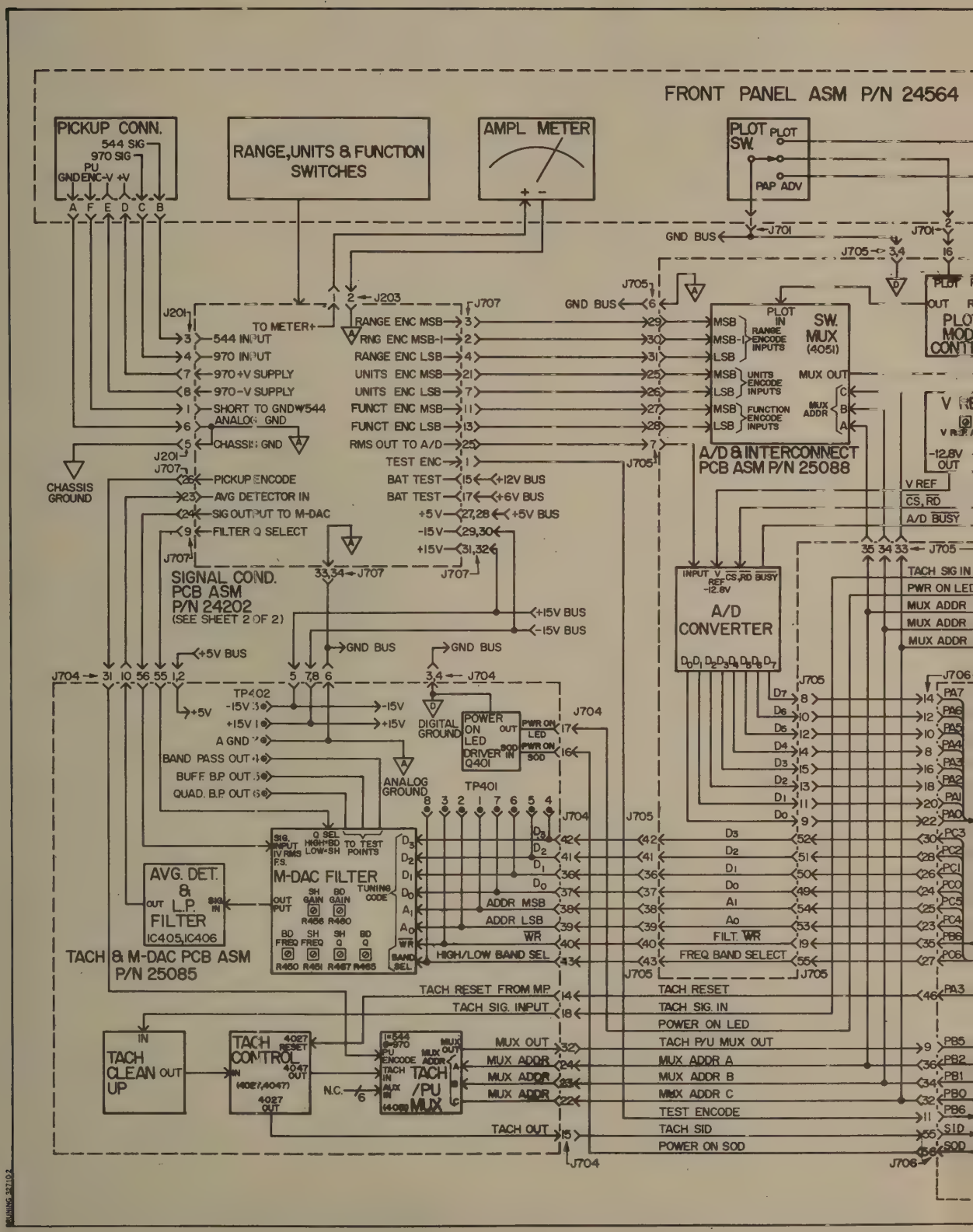


FIGURE 2-13 MICROPROCESSOR AND MAIN MEMORY PC BOARD COMPONENT LOCATIONS

2.5 820 ELECTRICAL BLOCK AND SCHEMATIC DIAGRAMS

This section contains the Electrical Block and Schematic Diagrams for the Model 820 circuits. The component reference numbers listed on these diagrams (R201, Q403, etc.) correspond to the Series Numbers of the various PC Boards (Fuse PC Board -- 600 Series components, etc.). In the Overall Block Diagram, Figure 2-14, the PC Board circuits are outlined with dotted enclosures, and the calibration controls and test points for these circuits are identified in the enclosures. The Electrical Schematic Diagrams are generally used as an aid for isolating circuit troubles on the PC Boards and for pinpointing malfunctioning components.

Figure	Description	Page
2-14	820 Overall Block Diagram (Dwg. No. D97359 - Sht. 1 of 2)	2-27
2-15	820 Signal Conditioner Block Diagram (Dwg. No. D97359 - Sht. 2 of 2)	2-28
2-16	Power Supply PC Board Circuits (Dwg. No. D95780)	2-29
2-17	Signal Conditioner PC Board Circuits (Dwg. No. D97370)	2-30
2-18	Analog/Digital and Interconnect PC Board Circuits (Dwg. No. D96014)	2-31
2-19	Tachometer and M-DAC Filter PC Board Circuits (Dwg. No. D96138)	2-32
2-20	Fuse PC Board Circuits (Dwg. No. D97372)	2-33
2-21	Microprocessor and Main Memory PC Board Circuits (Dwg. No. D96995)	2-34
2-22	Mother PC Board Circuits (Dwg. No. D96508)	2-35


FRONT PANEL ASM P/N 24564
PICKUP CONN.
544 SIG
970 SIG
PU GND ENC-V +V
A F E D C B
RANGE, UNITS & FUNCTION SWITCHES
AMPL METER
PLOT SW.
PLOT
PAP ADV
GND BUS
J701
J705
J707
J201
J203
TO METER+
544 INPUT
970 INPUT
970 +V SUPPLY
970 -V SUPPLY
SHORT TO GND W544
ANALOG GND
CHASSIS GND
CHASSIS GROUND
PICKUP ENCODE
AVG DETECTOR IN
SIG OUTPUT TO M-DAC
FILTER Q SELECT
RANGE ENC MSB
RNG ENC MSB-1
RANGE ENC LSB
UNITS ENC MSB
UNITS ENC LSB
FUNCT ENC MSB
FUNCT ENC LSB
RMS OUT TO A/D
TEST ENC
BAT TEST +12V BUS
BAT TEST +6V BUS
+5V +5V BUS
-15V
+15V
PLOT IN SW. MUX (4051)
RANGE ENCODE INPUTS
UNITS ENCODE INPUTS
FUNCTION ENCODE INPUTS
MUX ADDR
MUX OUT
A/D & INTERCONNECT PCB ASM P/N 25088
V REF
CS, RD
A/D BUSY
-12.8V OUT
SIGNAL COND. PCB ASM P/N 24202
(SEE SHEET 2 OF 2)
+15V BUS
-15V BUS
+5V BUS
GND BUS
A/D CONVERTER
TACH SIG IN
PWR ON LED
MUX ADDR
TP402
TP401
DIGITAL GROUND
ANALOG GROUND
POWER ON LED DRIVER Q401
BAND PASS OUT
BUFF B.P. OUT
QUAD. B.P. OUT
AVG. DET. & L.P. FILTER IC405, IC406
M-DAC FILTER
TUNING CODE
ADDR MSB
ADDR LSB
WR
HIGH/LOW BAND SEL
FILT. WR
FREQ BAND SELECT
TACH & M-DAC PCB ASM P/N 25085
TACH RESET FROM MP
TACH SIG. INPUT
TACH RESET
TACH SIG. IN
POWER ON LED
TACH P/U MUX OUT
MUX ADDR A
MUX ADDR B
MUX ADDR C
TEST ENCODE
TACH SID
POWER ON SOD
TACH OUT
TACH CLEAN UP
TACH CONTROL
TACH P/U MUX
N.C.

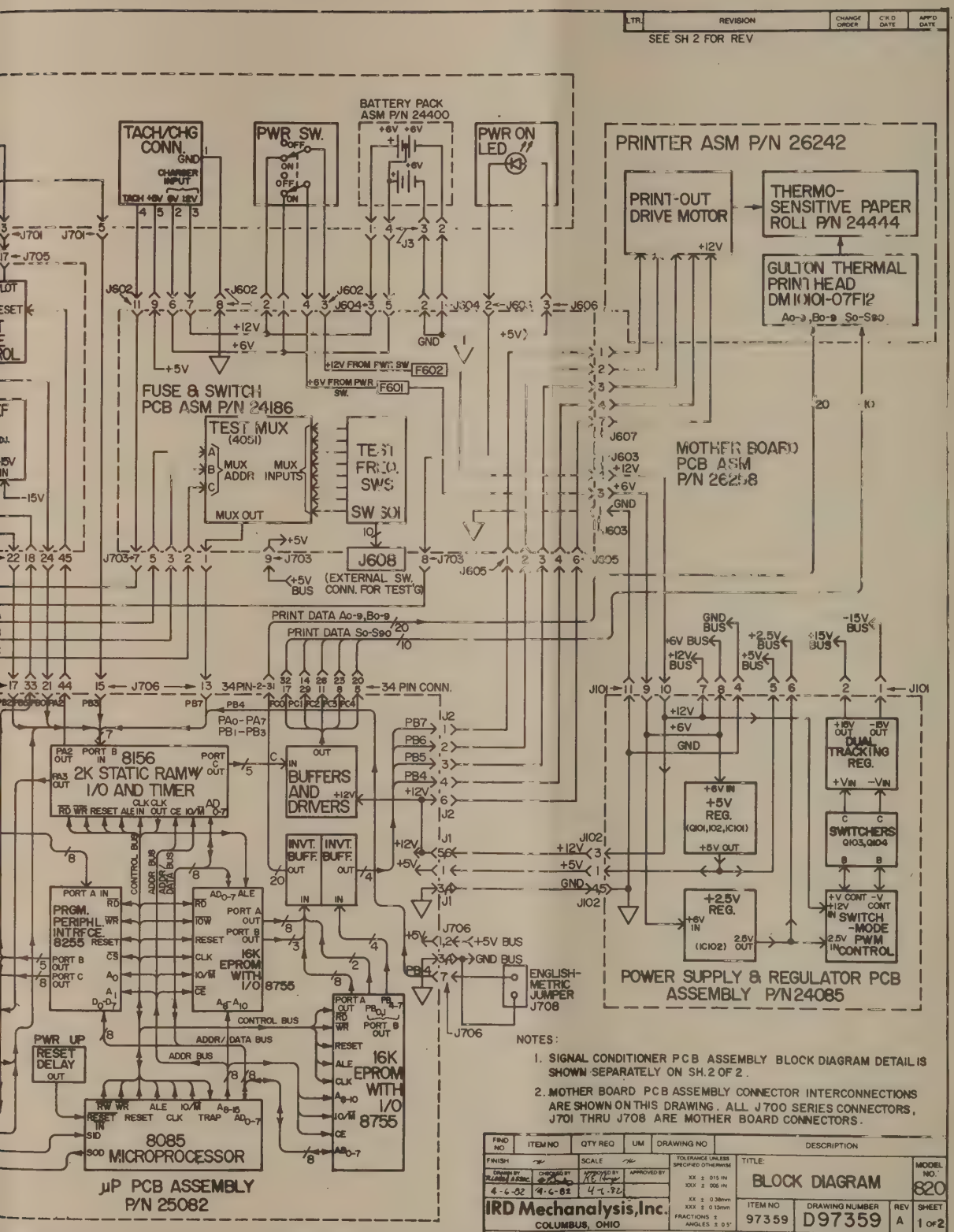
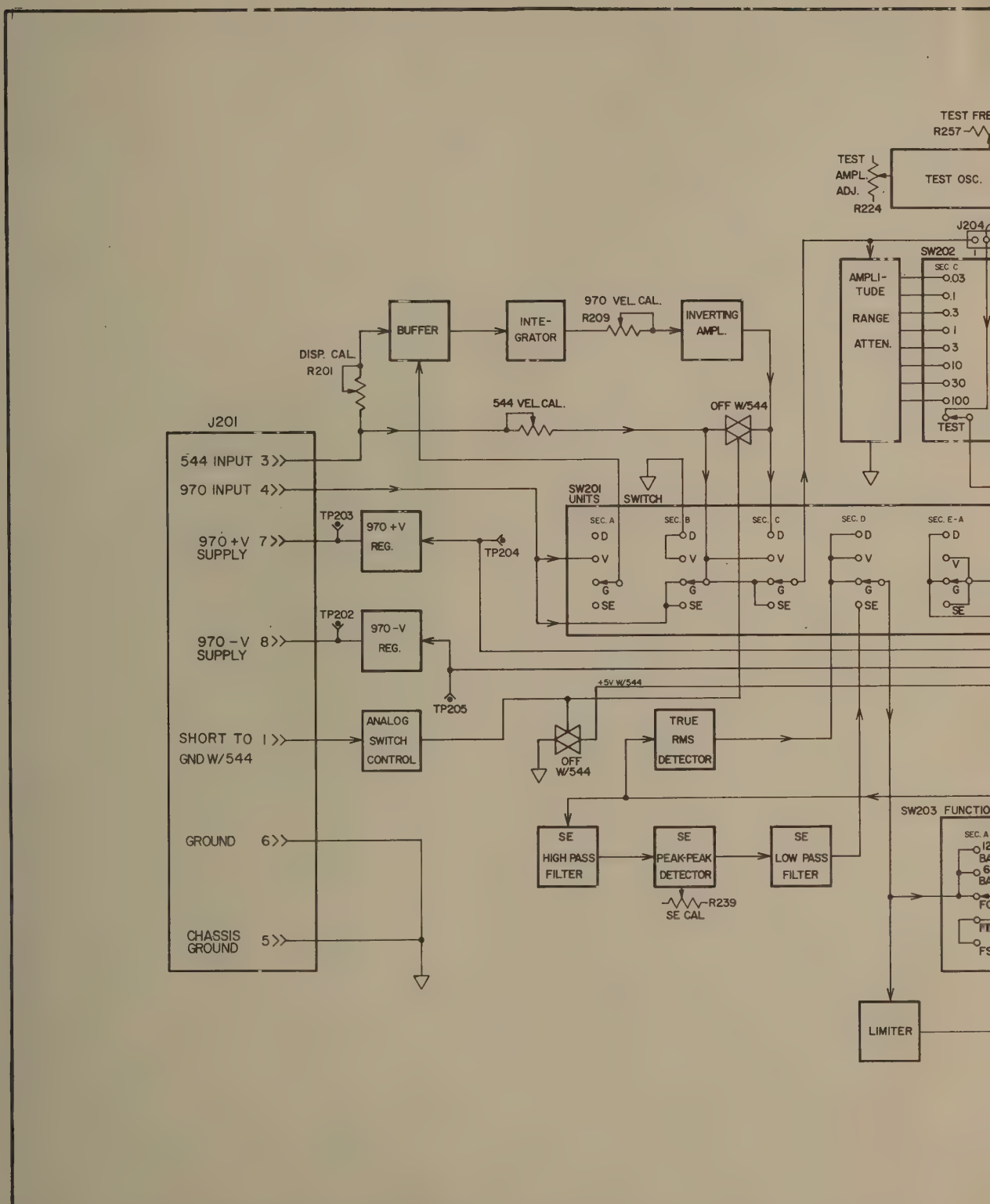


FIGURE 2-14 820 OVERALL BLOCK DIAGRAM


TEST FRE
R257
TEST
AMPL.
ADJ.
R224
TEST OSC.
J204
SW202
SEC. C
AMPLI-
TUDE
RANGE
ATTEN.
.03
.1
.3
1
3
10
30
100
TEST
970 VEL. CAL.
R209
BUFFER
INTE-
GRATOR
INVERTING
AMPL.
DISP. CAL.
R201
544 VEL. CAL.
OFF W/544
J201
544 INPUT 3
970 INPUT 4
970 +V
SUPPLY 7
970 -V
SUPPLY 8
SHORT TO
GND W/544 1
GROUND 6
CHASSIS
GROUND 5
TP203
970 +V
REG.
TP204
TP202
970 -V
REG.
TP205
SW201
UNITS
SWITCH
SEC. A
SEC. B
SEC. C
SEC. D
SEC. E-A
D
V
G
SE
+5V W/544
ANALOG
SWITCH
CONTROL
OFF
W/544
TRUE
RMS
DETECTOR
SE
HIGH PASS
FILTER
SE
PEAK-PEAK
DETECTOR
SE
LOW PASS
FILTER
R239
SE CAL
SW203 FUNCTIO
LIMITER

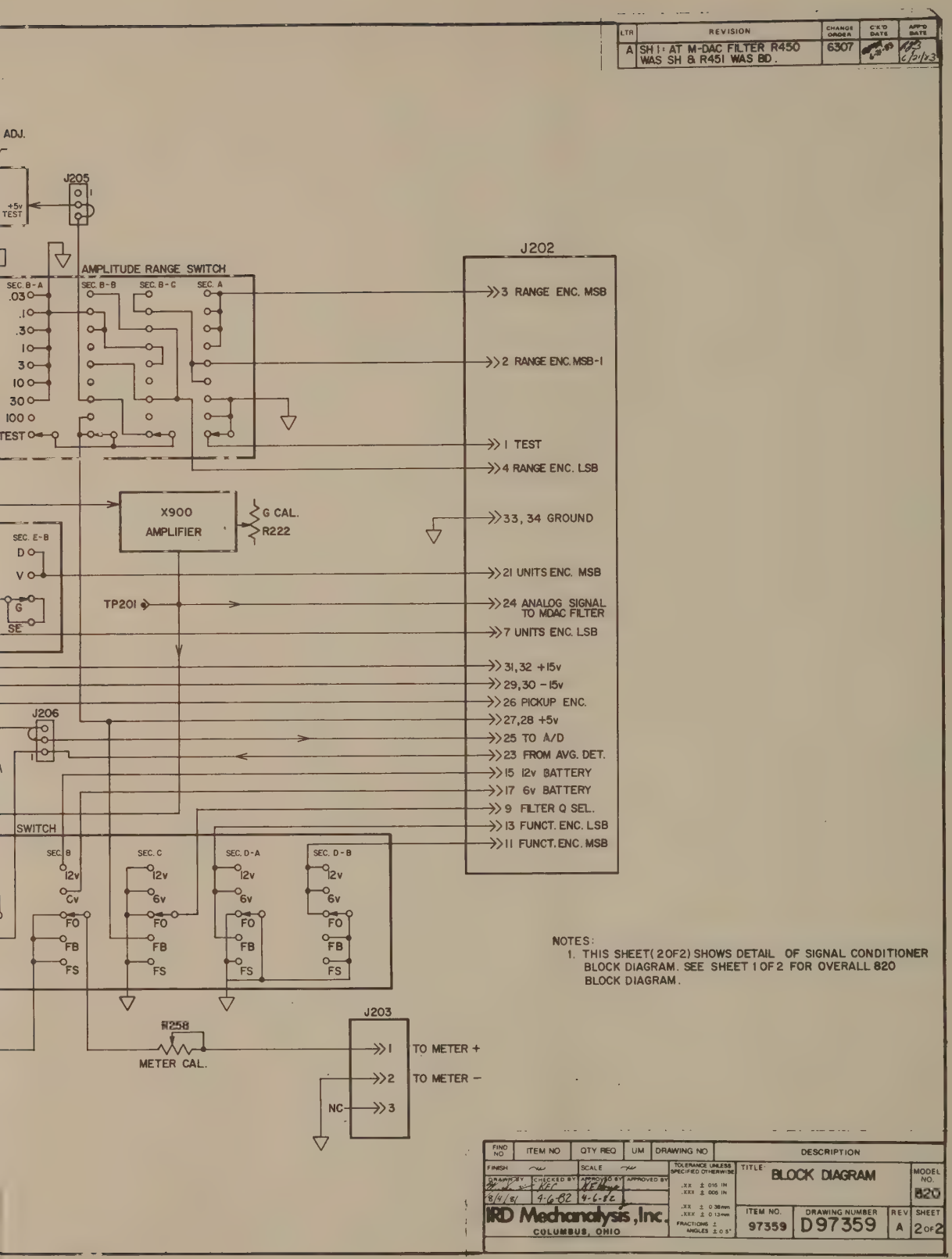
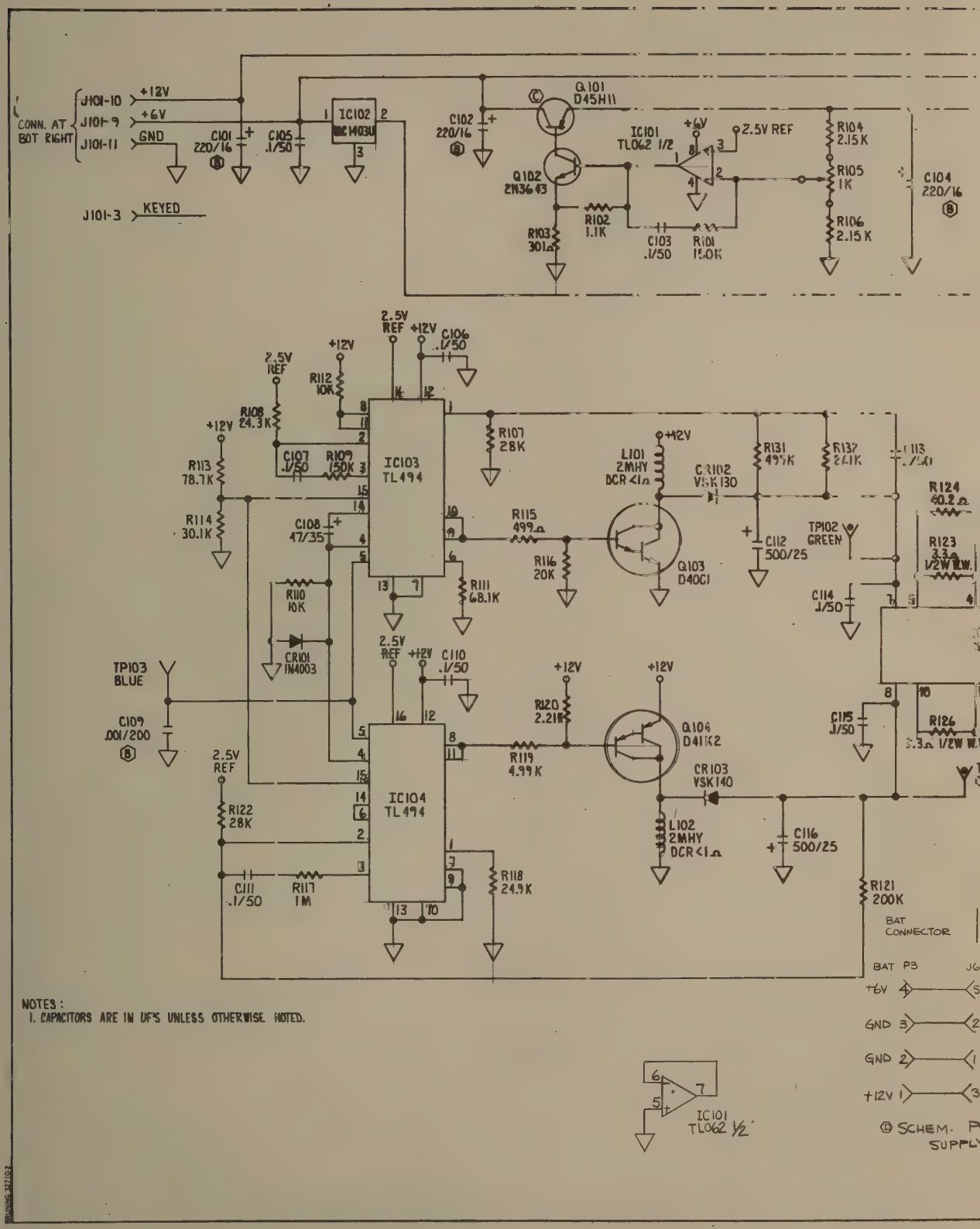
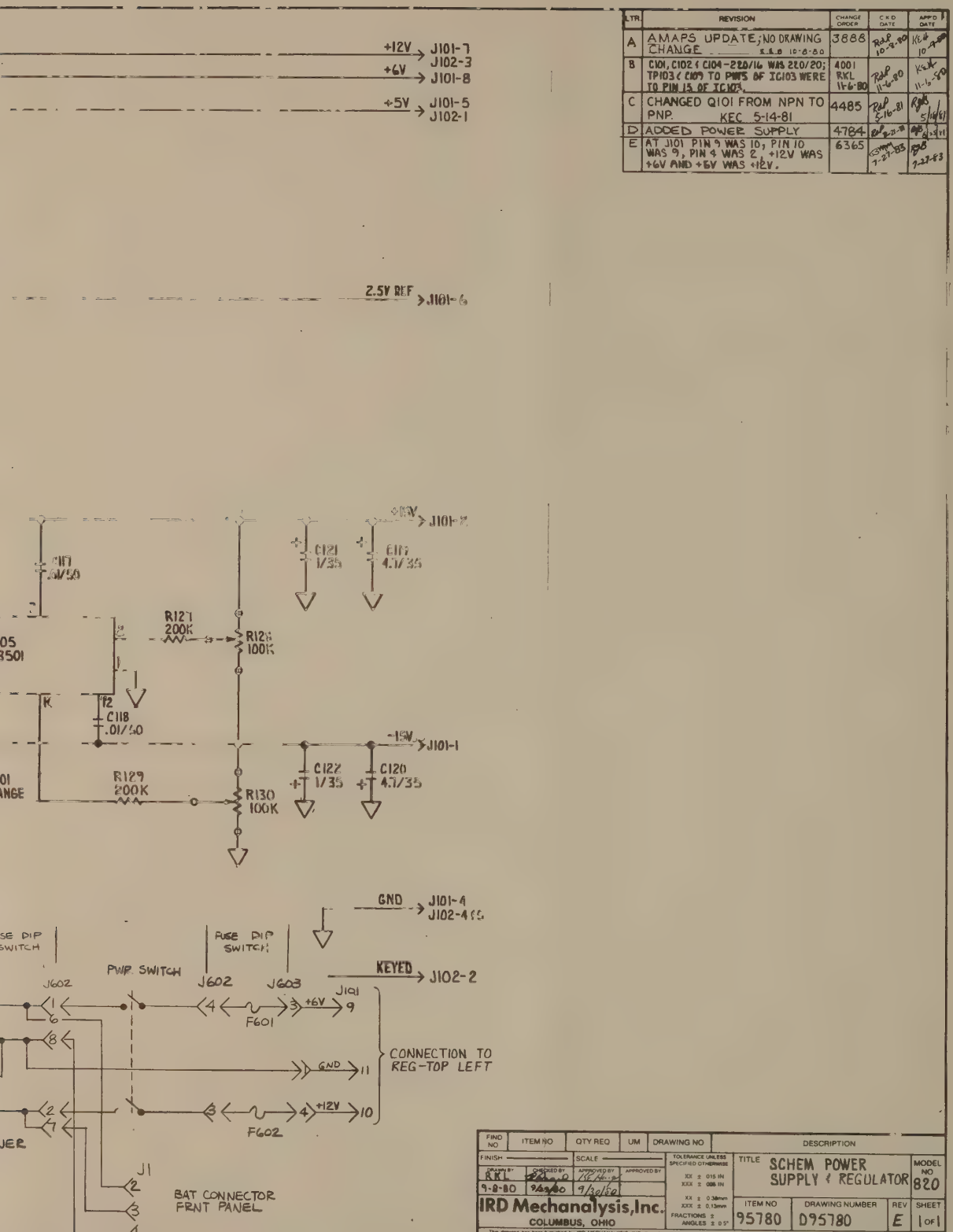


FIGURE 2-15 820 SIGNAL CONDITIONER BLOCK DIAGRAM



NOTES:
1. CAPACITORS ARE IN UF'S UNLESS OTHERWISE NOTED.



LTR	REVISION	CHANGE ORDER	CK'D DATE	APP'D DATE
A	AMAPS UPDATE; NO DRAWING CHANGE E.S.D 10-8-80	3888	RWP 10-8-80	10-8-80
B	C101, C102 & C104 - 220/16 WAS 220/20; TP103 & C109 TO PINS 8F IC103 WERE TO PIN 15 OF IC103.	4001 RKL 11-6-80	RWP 11-6-80	11-6-80
C	CHANGED Q101 FROM NPN TO PNP. KEC 5-14-81	4485	RWP 5-16-81	5/14/81
D	ADDED POWER SUPPLY	4784	RWP 2-2-83	2-2-83
E	AT J101 PIN 9 WAS 10, PIN 10 WAS 9, PIN 4 WAS 2, +12V WAS +6V AND +6V WAS +12V.	6365	[illegible] 7-27-83	RWP 7-27-83

FIND NO	ITEM NO	QTY REQ	UM	DRAWING NO	DESCRIPTION
FINISH		SCALE		TOLERANCE UNLESS SPECIFIED OTHERWISE	TITLE: SCHEM POWER SUPPLY & REGULATOR
DRAWN BY: RKL 9-8-80	CHECKED BY: [illegible]	APPROVED BY: [illegible] 9/30/80	APPROVED BY	XX ± .015 IN; XXX ± .005 IN; XX ± 0.38mm; XXX ± 0.13mm; FRACTIONS ± ; ANGLES ± 0.5°	MODEL NO: 820
IRD Mechanalysis, Inc. COLUMBUS, OHIO				ITEM NO: 95780	DRAWING NUMBER: D95780
					REV: E
					SHEET: 1 OF 1

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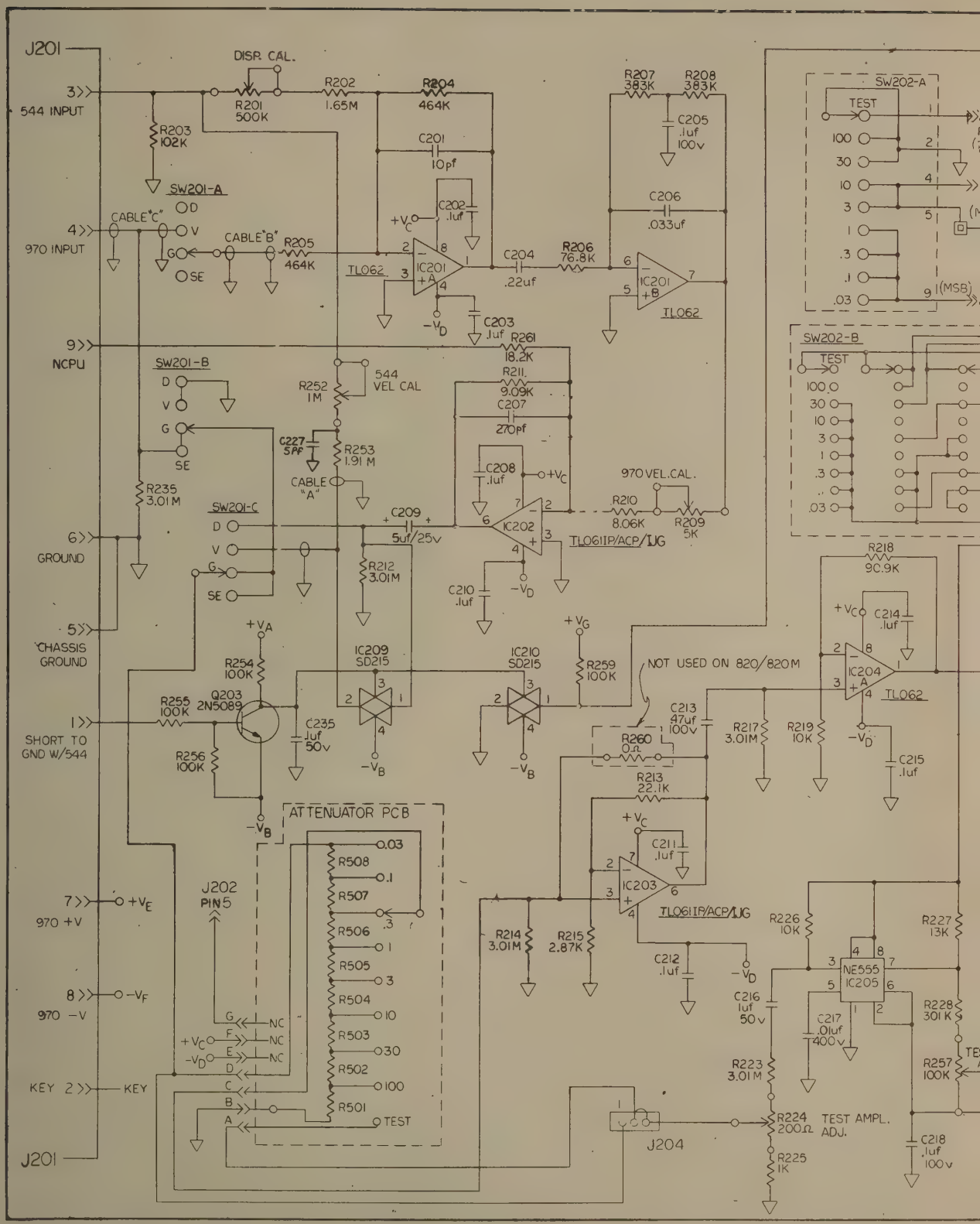
FIGURE 2-16 POWER SUPPLY PC BOARD CIRCUITS


J201
3
544 INPUT
4
970 INPUT
9
NCPU
6
GROUND
5
CHASSIS GROUND
1
SHORT TO GND W/544
7
970 +V
8
970 -V
KEY 2
KEY
J201
DISP. CAL.
R201 500K
R202 1.65M
R204 464K
R203 102K
C201 10pf
SW201-A
CABLE "C"
CABLE "B"
R205 464K
C202 .1uf
TL062
IC201
C203 .1uf
C204 .22uf
R206 76.8K
R207 383K
R208 383K
C205 .1uf 100v
C206 .033uf
SW202-A
TEST
100
30
10
3
1
.3
.1
.03
(MSB)
SW202-B
R261 18.2K
SW201-B
R252 1M
544 VEL CAL
R211 9.09K
C207 270pf
C227 5pf
R253 1.91 M
CABLE "A"
R235 3.01M
C208 .1uf
970 VEL.CAL.
R210 8.06K
R209 5K
SW201-C
C209 5uf/25v
IC202
TL061IP/ACP/UG
R212 3.01M
C210 .1uf
R218 90.9K
C214 .1uf
IC204
TL062
+VA
R254 100K
R255 100K
Q203 2N5089
R256 100K
IC209 SD215
IC210 SD215
R259 100K
NOT USED ON 820/820M
C213 47uf 100v
R260 0Ω
R217 3.01M
R219 10K
C215 .1uf
C235 1uf 50v
R213 22.1K
IC203
C211 .1uf
TL061IP/ACP/UG
R214 3.01M
R215 2.87K
C212 .1uf
ATTENUATOR PCB
J202 PIN5
R508
R507
R506
R505
R504
R503
R502
R501
0.03
0.1
.3
1
3
10
30
100
TEST
NC
R226 10K
R227 13K
NE555 IC205
C216 1uf 50v
C217 .01uf 400v
R228 301K
R223 3.01M
R257 100K
R224 200Ω TEST AMPL. ADJ.
R225 1K
J204
C218 .1uf 100v

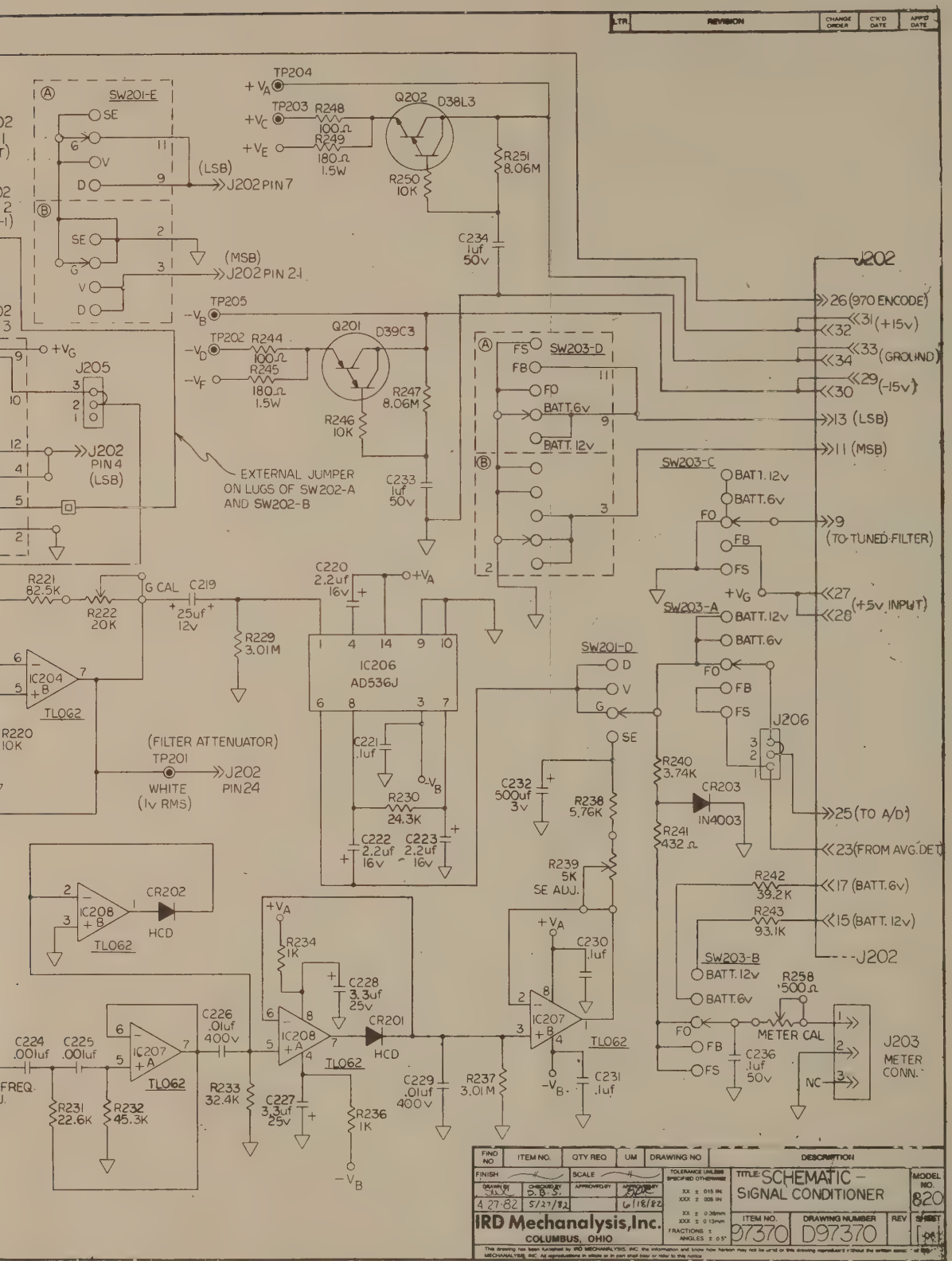
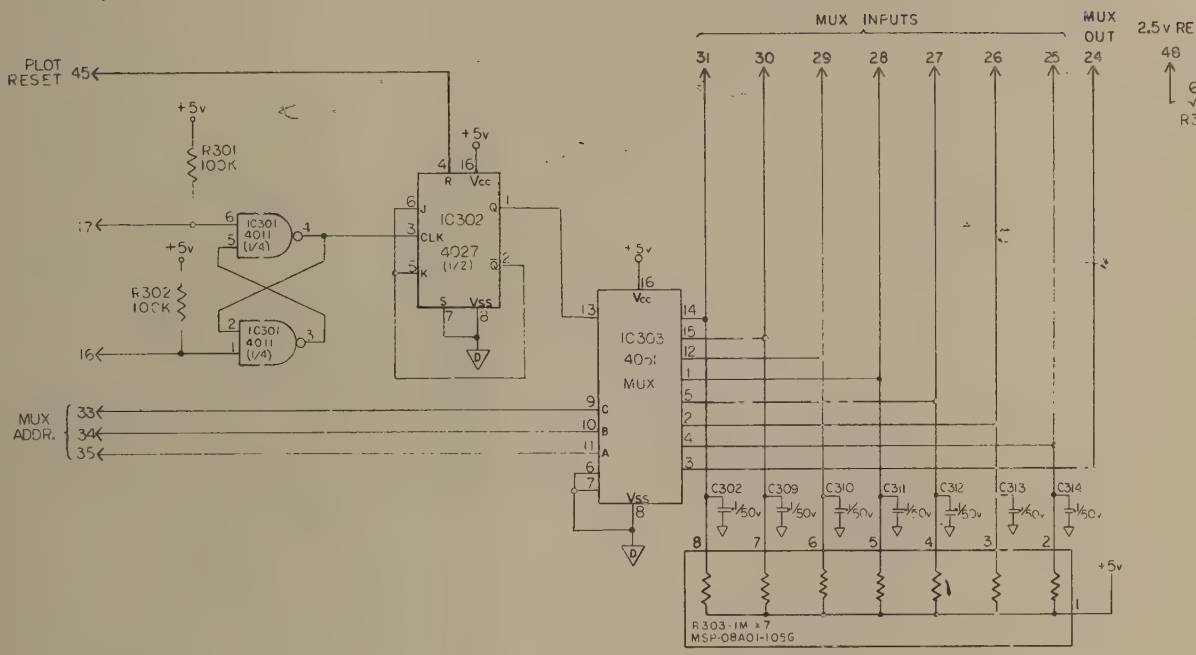
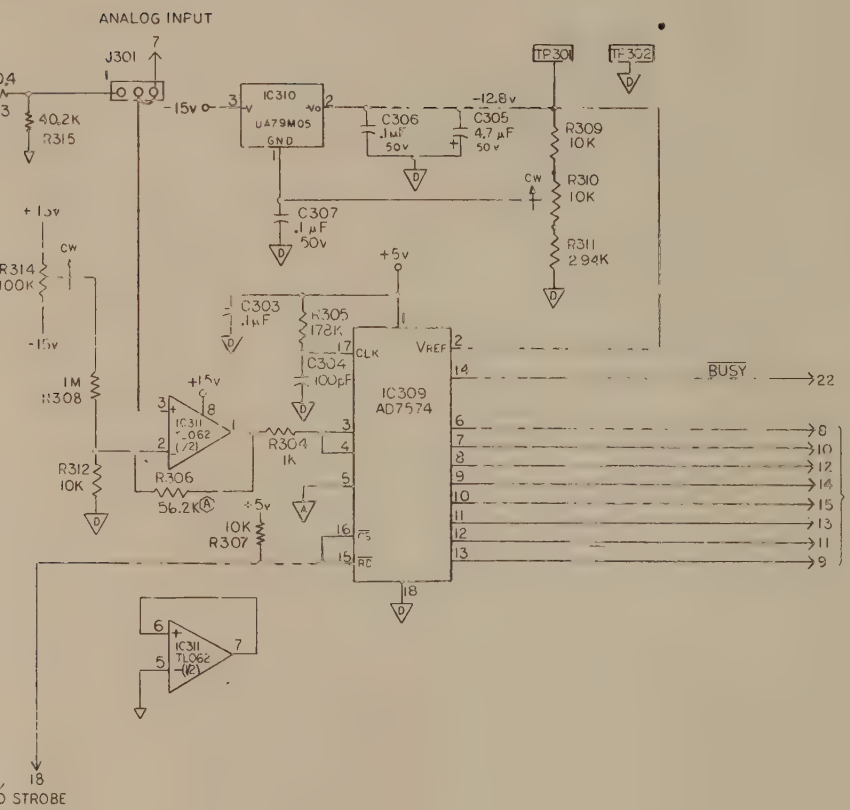


FIGURE 2-17 SIGNAL CONDITIONER PC BOARD CIRCUITS


MUX INPUTS
MUX OUT
2.5v REF
PLOT RESET 45
+5v
R301 100K
R302 100K
IC301 4011 (1/4)
IC302 4027 (1/2)
IC303 4051 MUX
MUX ADDR.
33
34
35
C302
C309
C310
C311
C312
C313
C314
1/50v
R303-1M x 7
MSP-08A01-105G
19 WR
55 HIGH BAND SELECT
54 A'
53 A°
52 D3
51 D2
50 D1
49 D0
+15v
-15v
ANALOG GND
GND

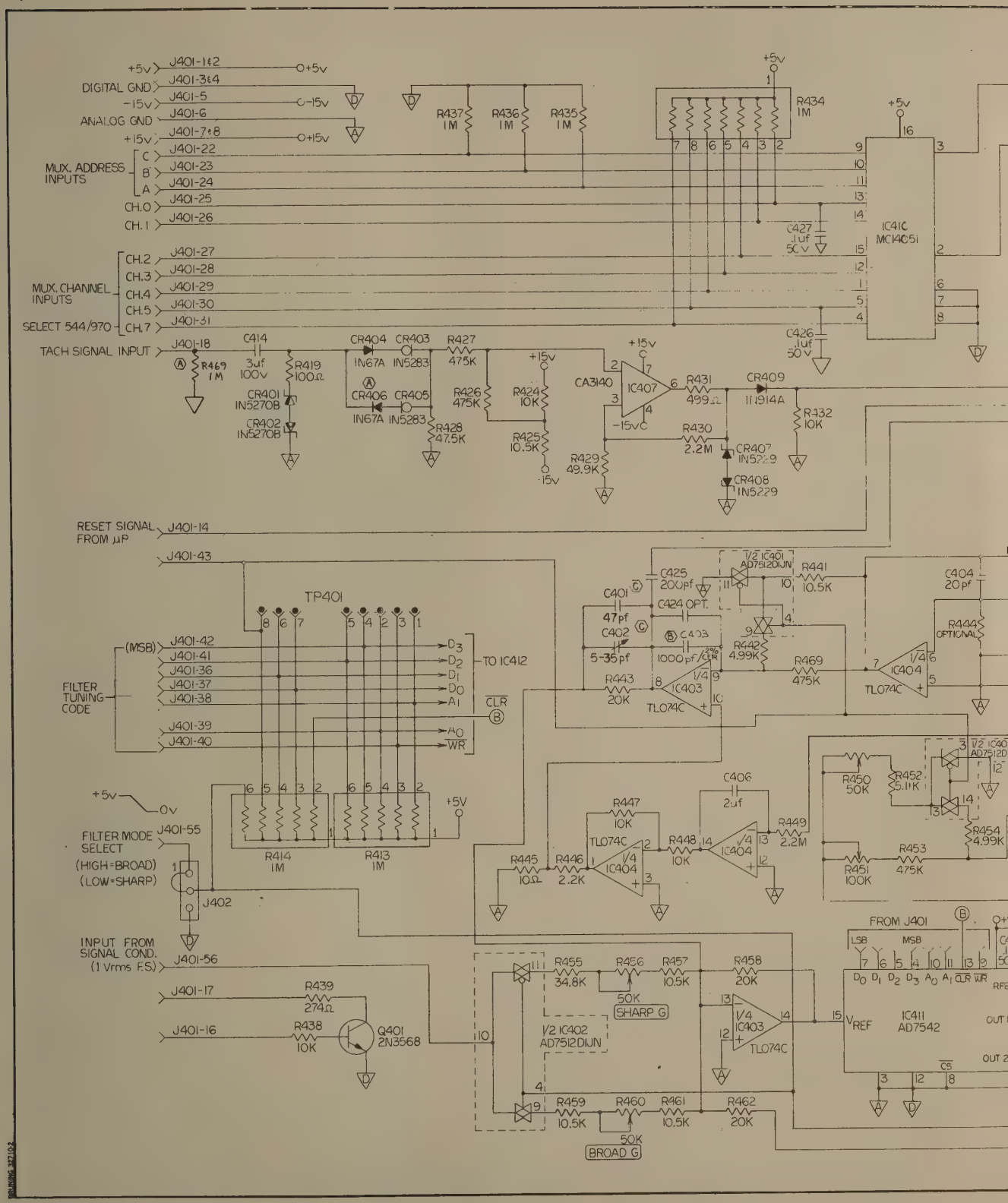
LTR	REVISION	CHANGE ORDER	CK'D DATE	APP'D DATE
A	R306 (56.2K) WAS 69.8K Sht 4/10/81	4354		



NOTE:
1. ALL RESISTORS ARE 1/8W, 1% M.F. UNLESS OTHERWISE NOTED

FIND NO	ITEM NO.	QTY REQ	UM	DRAWING NO.	DESCRIPTION
FINISH		SCALE		TOLERANCE UNLESS SPECIFIED OTHERWISE	TITLE: SCHEMATIC A/D & INTERCONNECT BD.
DRAWN BY R.E.C.	CHECKED BY R.M.	APPROVED BY	APPROVED BY	XX ± .010 IN. XXX ± .005 IN.	MODEL NO. 820
12-3-80	3-2-81	3/1/81		XX ± 0.38mm XXX ± 0.13mm FRACTIONS ± ANGLES ± 0.5°	
IRD Mechanalysis, Inc. COLUMBUS, OHIO				ITEM NO. 96014	DRAWING NUMBER D 96014 REV A

FIGURE 2-18 ANALOG/DIGITAL AND INTERCONNECT PC BOARD CIRCUITS


+5v
DIGITAL GND
-15v
ANALOG GND
+15v
J401-1&2
J401-3&4
J401-5
J401-6
J401-7&8
MUX. ADDRESS INPUTS
C
B
A
CH.0
CH.1
J401-22
J401-23
J401-24
J401-25
J401-26
MUX. CHANNEL INPUTS
CH.2
CH.3
CH.4
CH.5
CH.7
SELECT 544/970
J401-27
J401-28
J401-29
J401-30
J401-31
TACH SIGNAL INPUT
J401-18
R469 1M
C414 3uf 100v
R419 100Ω
CR401 IN5270B
CR402 IN5270B
CR404 IN67A
CR403 IN5283
CR406 IN67A
CR405 IN5283
R427 475K
R428 47.5K
R426 475K
R424 10K
R425 10.5K
CA3140
IC407
R429 49.9K
R431 499Ω
R430 2.2M
CR409 1N914A
CR407 IN5229
CR408 IN5229
R432 10K
R434 1M
R437 1M
R436 1M
R435 1M
C427 .1uf 50v
C426 .1uf 50v
IC410 MC14051
RESET SIGNAL FROM µP
J401-14
J401-43
TP401
FILTER TUNING CODE
(MSB)
J401-42
J401-41
J401-36
J401-37
J401-38
J401-39
J401-40
D3
D2
D1
D0
A1
A0
WR
CLR
TO IC412
C425 200pf
C401 47pf
C424 OPT.
C402 5-35pf
C403 1000pf
R442 4.99K
R443 20K
R441 10.5K
R469 475K
IC403 TLO74C
IC404 TLO74C
C404 20pf
R444 OPTIONAL
R414 1M
R413 1M
FILTER MODE SELECT
(HIGH=BROAD)
(LOW=SHARP)
J401-55
J402
INPUT FROM SIGNAL COND. (1 Vrms F.S.)
J401-56
J401-17
J401-16
R439 274Ω
R438 10K
Q401 2N3568
C406 2uf
R447 10K
R448 10K
R449 2.2M
R445 10Ω
R446 2.2K
R450 50K
R452 5.11K
R454 4.99K
R451 100K
R453 475K
R455 34.8K
R456 50K SHARP G
R457 10.5K
R458 20K
R459 10.5K
R460 50K BROAD G
R461 10.5K
R462 20K
1/2 IC402 AD7512DIJN
IC411 AD7542
FROM J401
LSB
MSB
VREF
CS
OUT 1
OUT 2

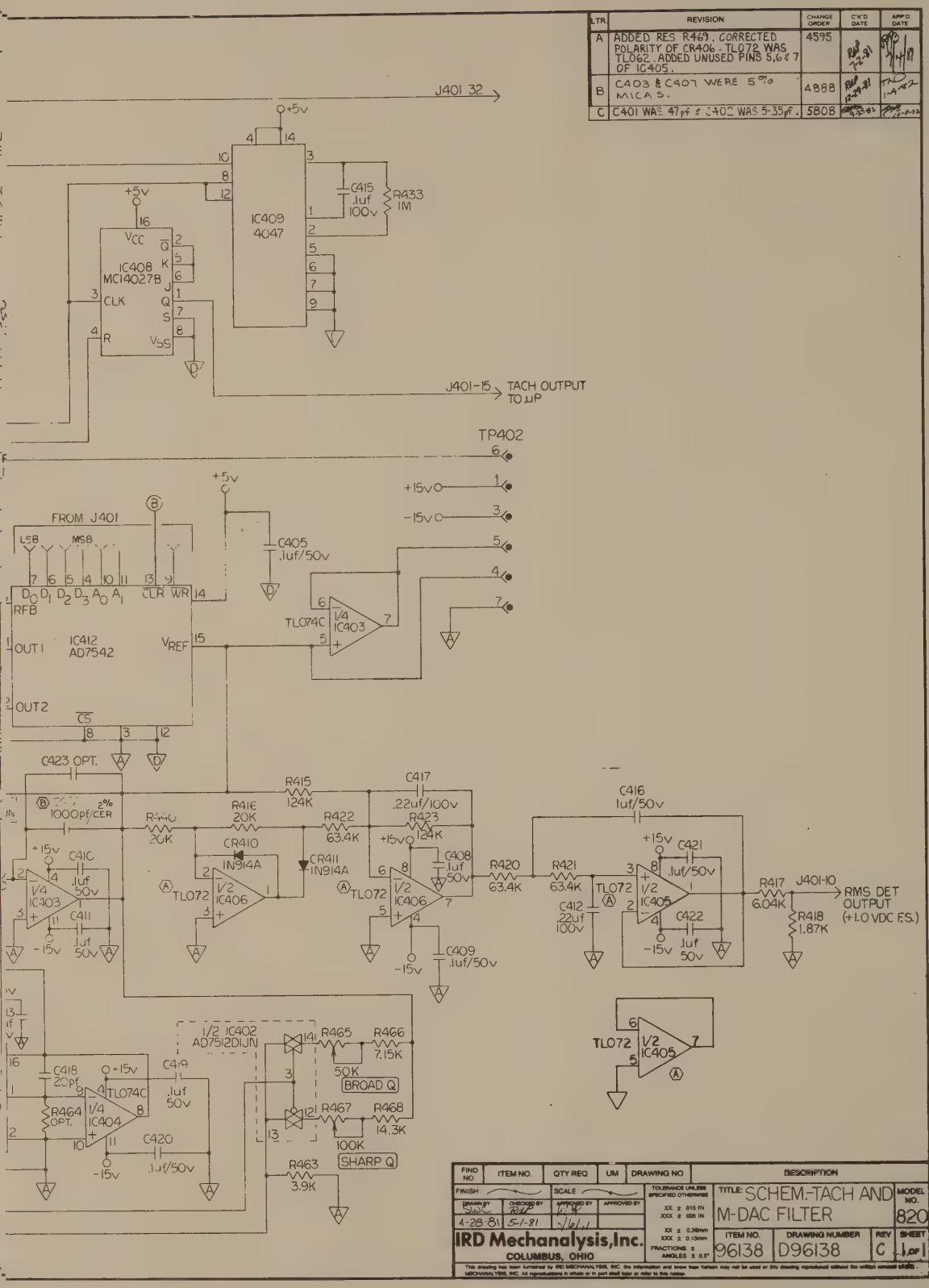
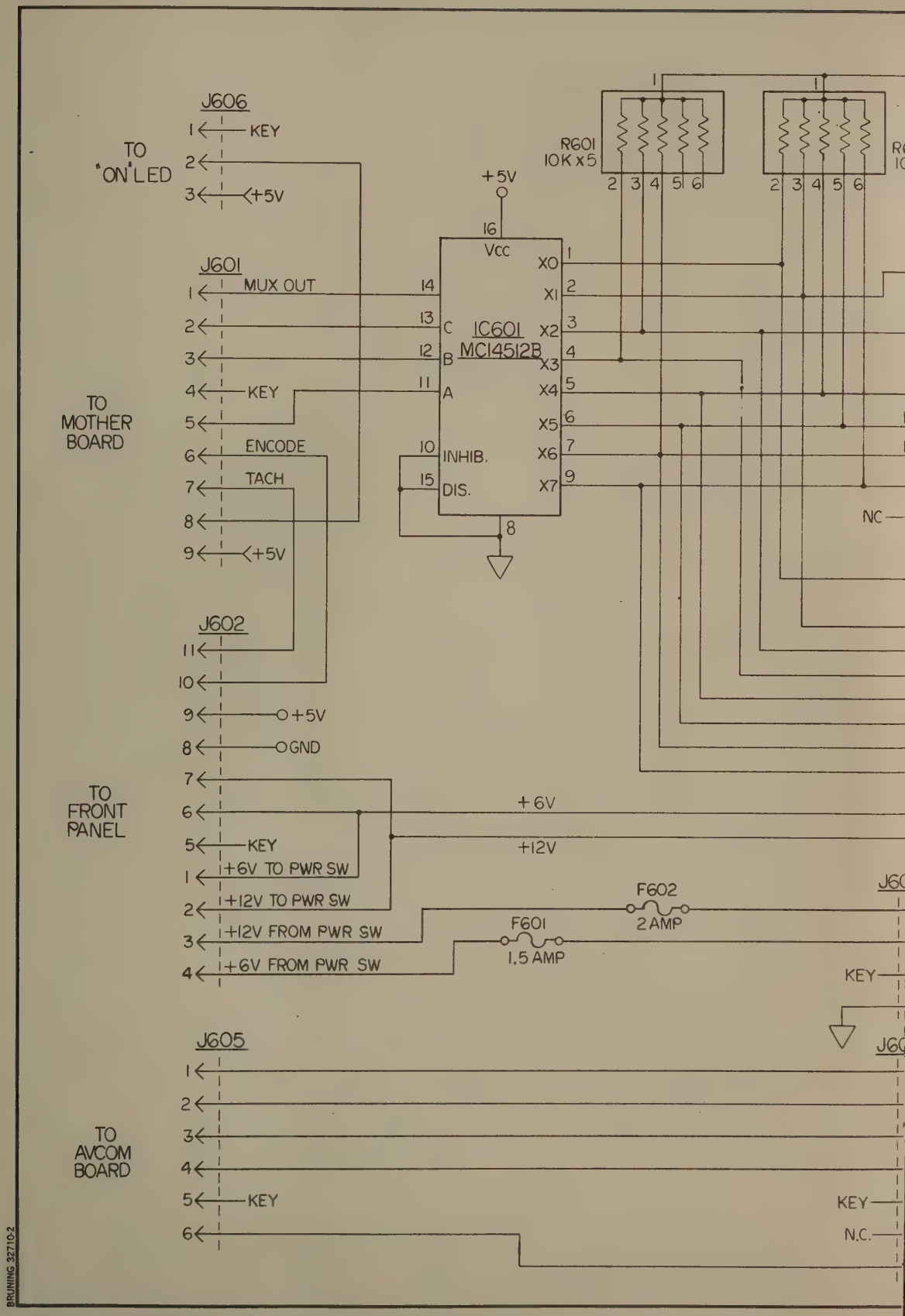


FIGURE 2-19 TACHOMETER AND M-DAC FILTER PC BOARD CIRCUITS


J606
1 KEY
2
3 +5V
TO "ON" LED
J601
1 MUX OUT
2
3
4 KEY
5
6 ENCODE
7 TACH
8
9 +5V
TO MOTHER BOARD
R601 10K x5
+5V
16 Vcc
IC601 MC14512B
14
13 C
12 B
11 A
10 INHIB.
15 DIS.
8
X0 1
X1 2
X2 3
X3 4
X4 5
X5 6
X6 7
X7 9
NC
J602
11
10
9 +5V
8 GND
7
6
5 KEY
1 +6V TO PWR SW
2 +12V TO PWR SW
3 +12V FROM PWR SW
4 +6V FROM PWR SW
TO FRONT PANEL
+6V
+12V
F602 2 AMP
F601 1.5 AMP
KEY
J605
1
2
3
4
5 KEY
6
TO AVCOM BOARD
KEY
N.C.
BRUNING 32710-2

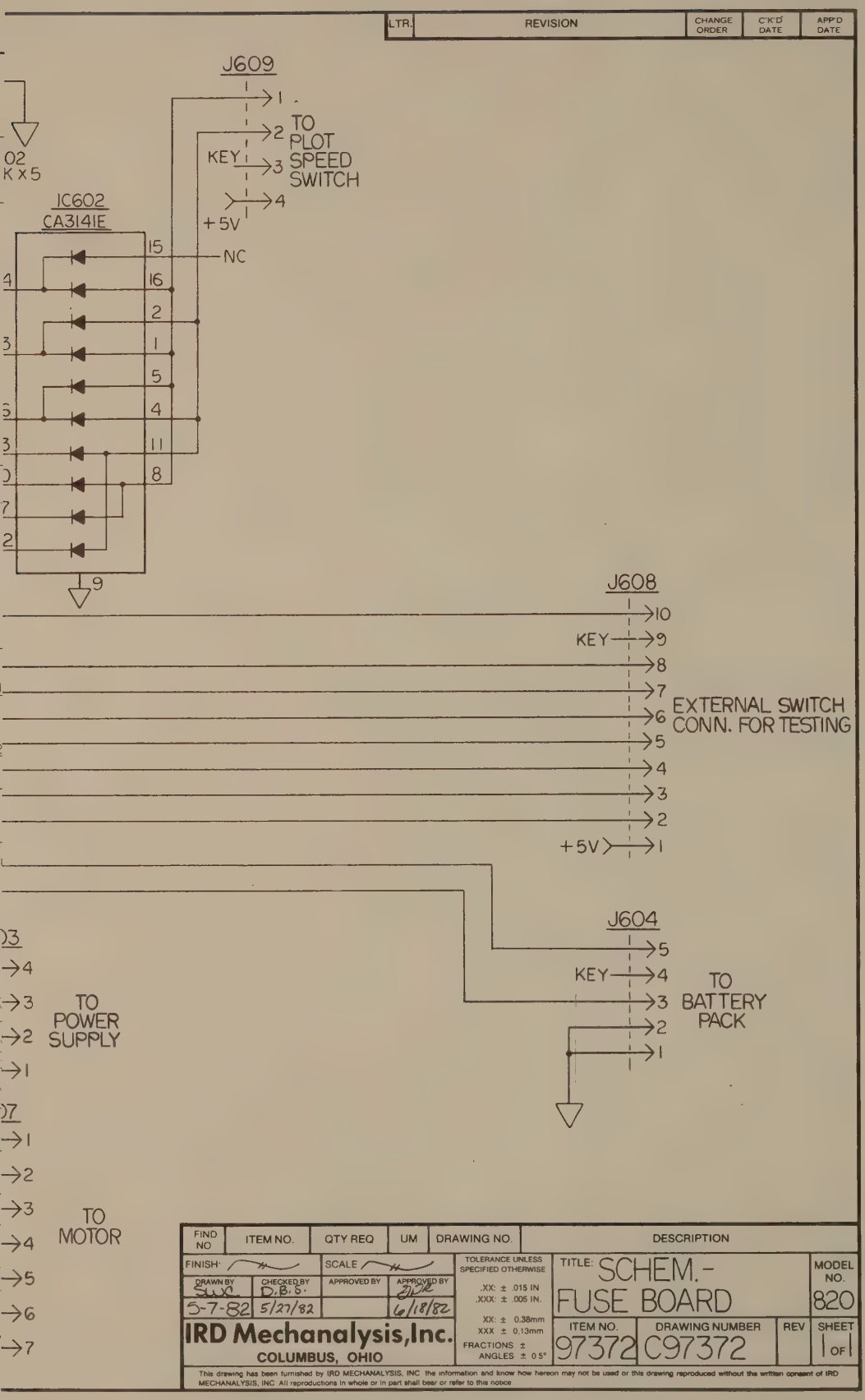
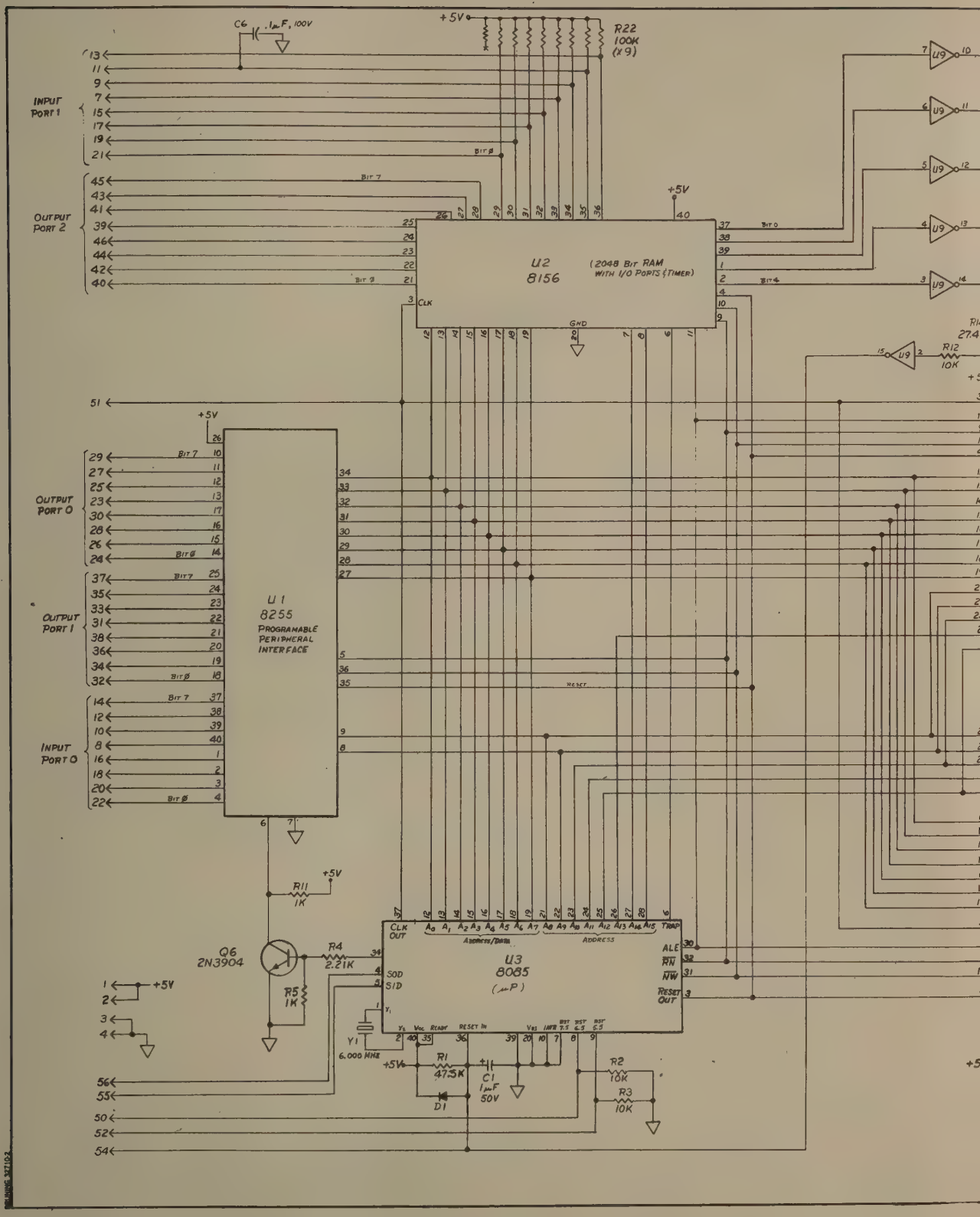


FIGURE 2-20 FUSE PC BOARD CIRCUITS


C6 .1μF, 100V
+5V
R22 100K (X9)
INPUT PORT 1
OUTPUT PORT 2
BIT 7
BIT 0
BIT 4
BIT 3
U2 8156
(2048 BIT RAM WITH I/O PORTS & TIMER)
CLK
GND
U9
R12 10K
OUTPUT PORT 0
OUTPUT PORT 1
INPUT PORT 0
U1 8255 PROGRAMABLE PERIPHERAL INTERFACE
RESET
R11 1K
Q6 2N3904
R4 2.21K
R5 1K
U3 8085 (μP)
CLK OUT
SOD
SID
ALE
RD
WR
RESET OUT
TRAP
Y1 6.000 MHz
R1 47.5K
C1 1μF 50V
D1
R2 10K
R3 10K

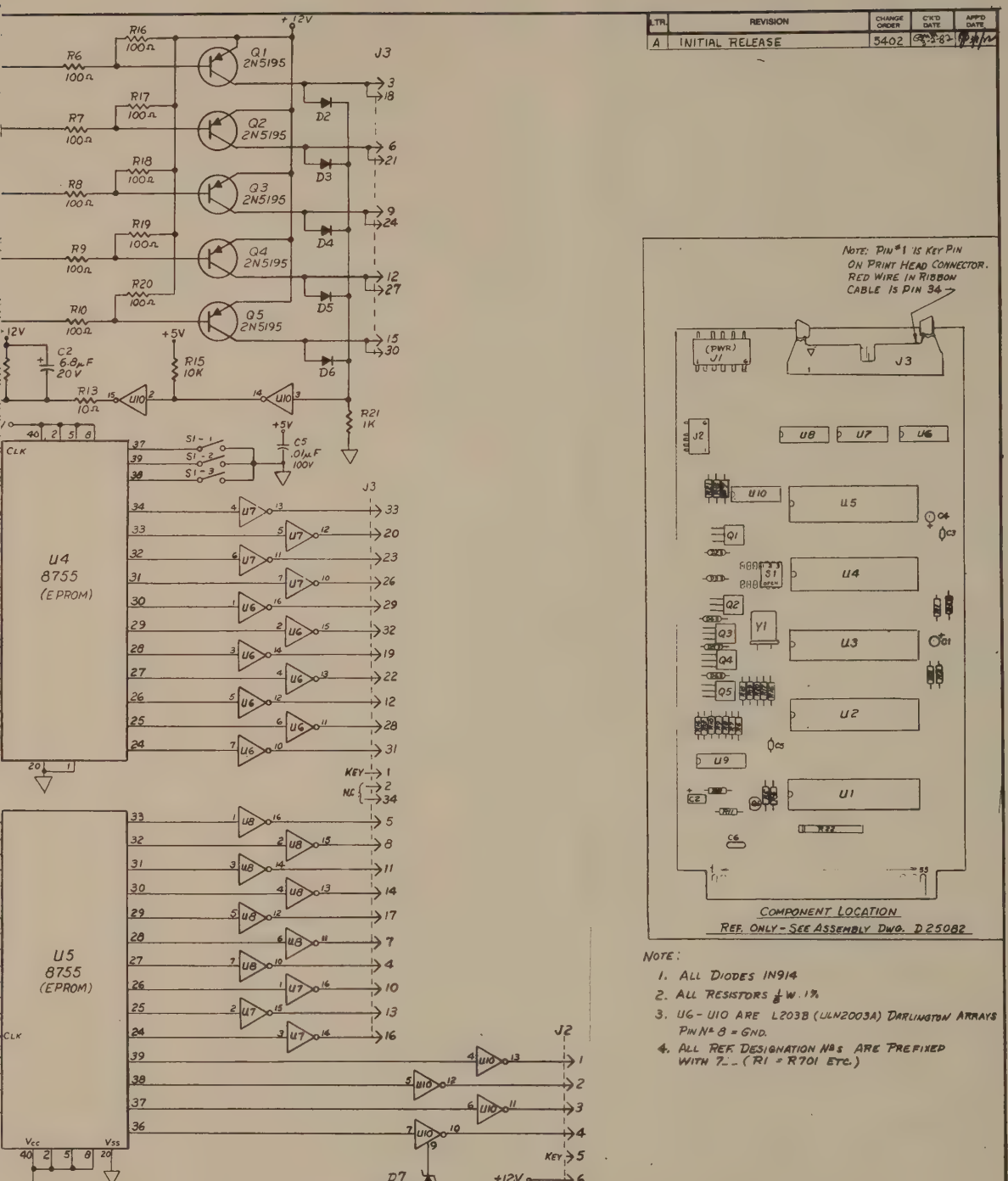
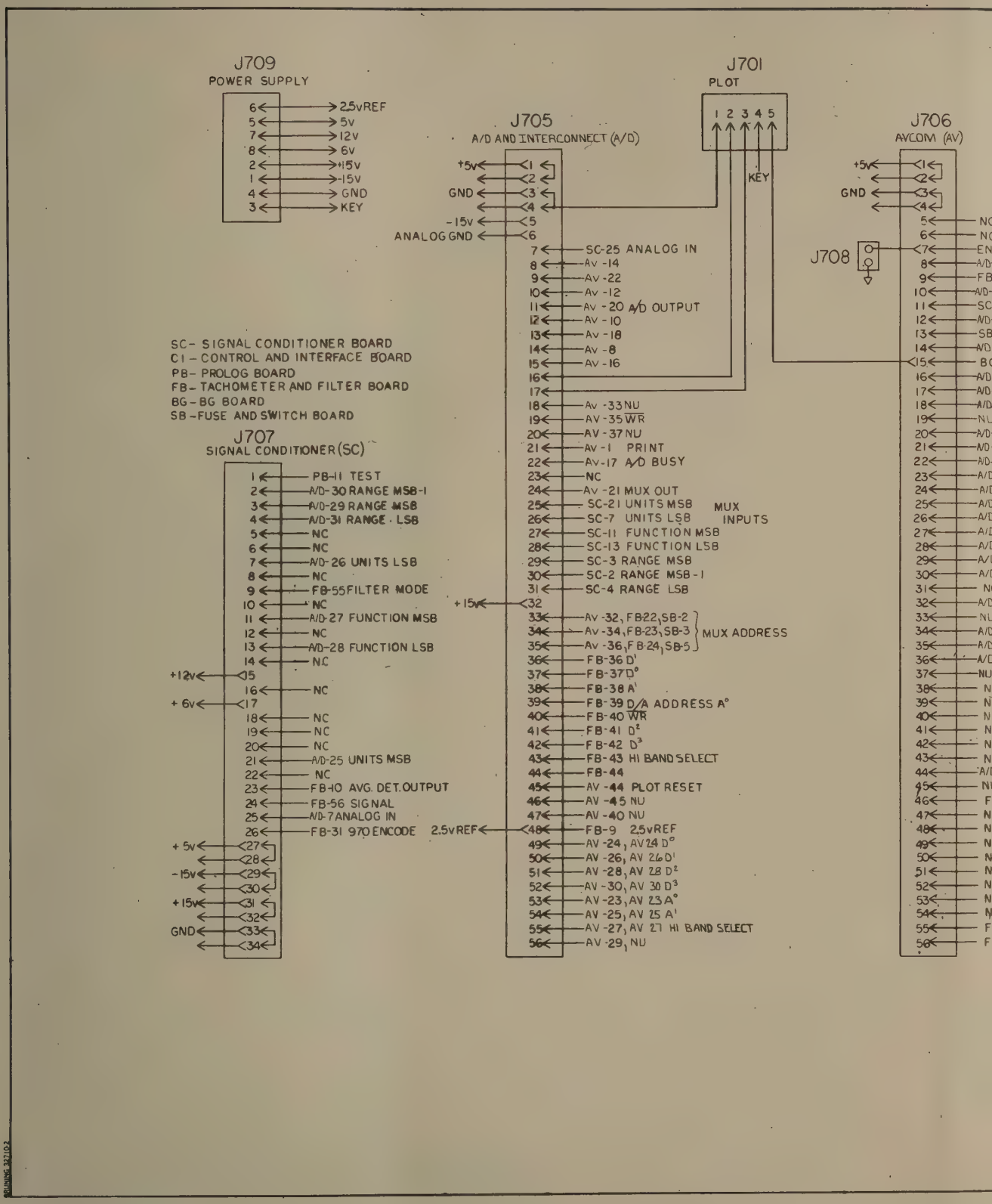


FIGURE 2-21 MICROPROCESSOR AND MAIN MEMORY PC BOARD CIRCUITS


J709
POWER SUPPLY
6 → 2.5vREF
5 → 5v
7 → 12v
8 → 6v
2 → +15v
1 → -15v
4 → GND
3 → KEY
J701
PLOT
1 2 3 4 5
KEY
J705
A/D AND INTERCONNECT (A/D)
+5v 1
2
GND 3
4
-15v 5
ANALOG GND 6
7 SC-25 ANALOG IN
8 Av -14
9 Av -22
10 Av -12
11 Av -20 A/D OUTPUT
12 Av -10
13 Av -18
14 Av -8
15 Av -16
16
17
18 Av -33 NU
19 Av -35 WR
20 Av -37 NU
21 Av -1 PRINT
22 Av -17 A/D BUSY
23 NC
24 Av -21 MUX OUT
25 SC-21 UNITS MSB
26 SC-7 UNITS LSB
27 SC-11 FUNCTION MSB
28 SC-13 FUNCTION LSB
29 SC-3 RANGE MSB
30 SC-2 RANGE MSB-1
31 SC-4 RANGE LSB
MUX INPUTS
+15v 32
33 Av -32, FB-22, SB-2
34 Av -34, FB-23, SB-3
35 Av -36, FB-24, SB-5
MUX ADDRESS
36 FB-36 D¹
37 FB-37 D⁰
38 FB-38 A¹
39 FB-39 D/A ADDRESS A⁰
40 FB-40 WR
41 FB-41 D²
42 FB-42 D³
43 FB-43 HI BAND SELECT
44 FB-44
45 AV -44 PLOT RESET
46 AV -45 NU
47 AV -40 NU
48 FB-9 2.5vREF
2.5vREF
49 AV -24, AV 24 D⁰
50 AV -26, AV 26 D¹
51 AV -28, AV 28 D²
52 AV -30, AV 30 D³
53 AV -23, AV 23 A⁰
54 AV -25, AV 25 A¹
55 AV -27, AV 27 HI BAND SELECT
56 AV -29, NU
J706
AVCOM (AV)
+5v 1
2
GND 3
4
5 NC
6 NC
J708
7 EN
8 A/D
9 FB
10 A/D
11 SC
12 A/D
13 SB
14 A/D
15 BG
16 A/D
17 A/D
18 A/D
19 NU
20 A/D
21 A/D
22 A/D
23 A/D
24 A/D
25 A/D
26 A/D
27 A/D
28 A/D
29 A/D
30 A/D
31 NC
32 A/D
33 NU
34 A/D
35 A/D
36 A/D
37 NU
38 NC
39 NC
40 NC
41 NC
42 NC
43 NC
44 A/D
45 NU
46 FB
47 NC
48 NC
49 NC
50 NC
51 NC
52 NC
53 NC
54 NC
55 FB
56 FB
SC- SIGNAL CONDITIONER BOARD
CI - CONTROL AND INTERFACE BOARD
PB- PROLOG BOARD
FB- TACHOMETER AND FILTER BOARD
BG- BG BOARD
SB - FUSE AND SWITCH BOARD
J707
SIGNAL CONDITIONER (SC)
1 PB-11 TEST
2 A/D-30 RANGE MSB-1
3 A/D-29 RANGE MSB
4 A/D-31 RANGE LSB
5 NC
6 NC
7 A/D-26 UNITS LSB
8 NC
9 FB-55 FILTER MODE
10 NC
11 A/D-27 FUNCTION MSB
12 NC
13 A/D-28 FUNCTION LSB
14 NC
+12v 15
16 NC
+6v 17
18 NC
19 NC
20 NC
21 A/D-25 UNITS MSB
22 NC
23 FB-10 AVG. DET. OUTPUT
24 FB-56 SIGNAL
25 A/D-7 ANALOG IN
26 FB-31 970 ENCODE
+5v 27
28
-15v 29
30
+15v 31
32
GND 33
34

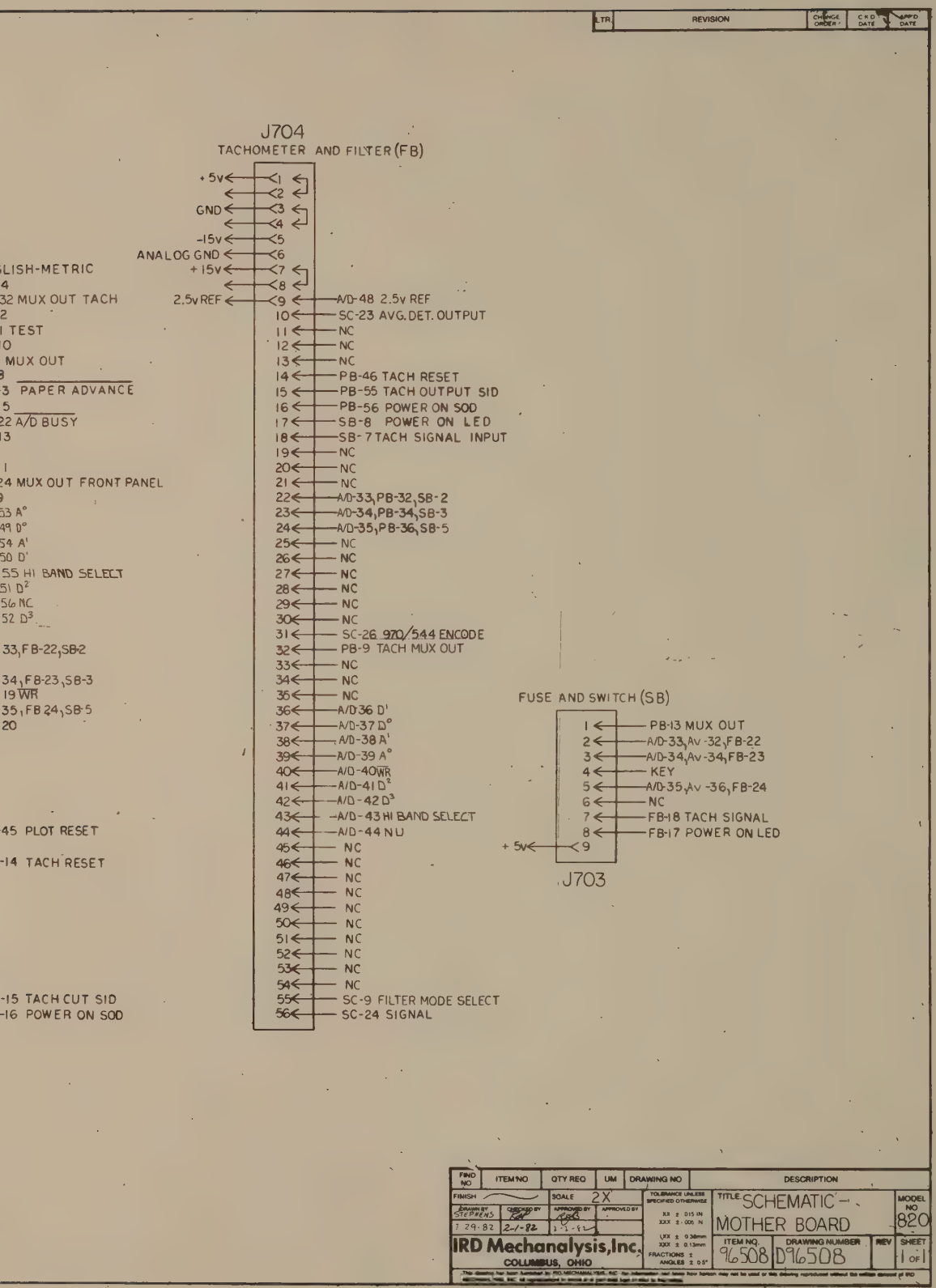


FIGURE 2-22 MOTHER PC BOARD CIRCUITS

APPENDIX A-1 INSTRUMENT UPDATE RECORD

The following table contains a summary of the changes incorporated in the Model 820 at the instrument updatings. The changes listed are keyed to a corresponding Serial Number Prefix Letter which identifies the instrument configuration, or revision level, at the time of manufacture. When a Suffix Letter follows the Serial Number, it identifies the revision level to which the instrument has been updated by the IRD Mechanalysis Service Department or Agency.

In the table below, the reference ECO numbers and the approximate revision dates are included along with the corresponding descriptions of the changes provided. The Prefix Letter listed for the most recent updating is also printed on the face page of this manual. Instrument revisions that are provided after this date are described in a separate addendum.

UPDATE RECORD

PREFIX LETTER	SUMMARY OF REVISION	REVISION DATE	ECO NUMBER
	FIRST PRINTING OF MANUAL - 8/82		
C	Enhanced version - instrument modified as follows: • Signal Cond. PCB Assm. - P/N 27693 • Fuse PCB Assm. - P/N 27700 • Mother PCB Assm. - P/N 25355 • Micro. PCB Assm. - P/N 27699 • Signal Cond. PCB Schematic Dwg. - D97370 • Fuse PCB Schematic Dwg. - D97372 • Mother PCB Schematic Dwg. - D96508 • Lid Actuated Cut-off Switch • 3-Position Chart Speed Toggle Switch • Non-Contact Pickup input connection	11/82	5561
D	Misc. hardware changes	11/82	5896
E	Program No. 2 EPROM (Micro PCB) changed from P/N 27730 to P/N 29618	3/84	6631
	SECOND PRINTING OF MANUAL - 3/84 Manual text, Parts Lists, and schematics revised per Prefix "E" modifications		

APPENDIX A-2 CUSTOMER SERVICE AGENCIES

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Columbus, Ohio 43229
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Telex: 24:5318

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Houston, Texas 77054
Phone: 713/667-0941

IRD MECHANALYSIS, INC.
1131 Warren Avenue
Downers Grove, Ill. 60515
Phone: 312/960-4065

IRD MECHANALYSIS, INC.
Suite 202
3130 Maple Drive, N.E.
Atlanta, Georgia 30305
Phone: 404/237-4875

IRD MECHANALYSIS, INC.
Suite A2
221 So. Chester Pike
Glenolden, Penn. 19036
Phone: 215/461-7060

IRD MECHANALYSIS, INC.
Suite 4
3377 Mount Diablo Blvd.
Lafayette, Calif. 94549
Phone: 415/283-2065

CANADA

IRD MECHANALYSIS LIMITED
333 Barton Street East
Stoney Creek, (Hamilton)
Ontario, Canada L8E 2L1
Phone: 416/662-7577
Telex: 061-8453
Telex: 851-617034 IRD MECH G

IRD MECHANALYSIS LIMITED
Room 301
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Calgary, Alberta
Canada T2S 0B2
Phone: 403/264-4130
Telex: 03-824680

UNITED KINGDOM

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Sealand Industrial Estate
Chester, United Kingdom CH1 4LT
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Chester 44/244/317557-8

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IRD MECHANALYSIS, S.A.
Avenue Winston Churchill 98
B1180 Brussels, Belgium
Phone: 32/2/344.70.58
32/2/344.72.18
Telex: 846-61256 IRD BRU B

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23a, Rue Brongniart
F92310 Sevres
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Phone: (1) 534 42 96

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Crows Nest, NSW 2065
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Phone: (02) 929 8122
Telex: AA 23193

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47/48 Jolly Maker Chambers II
Nariman Point
Post Office Box 991
Bombay 400 021, India
Phone: 230430
Telex: 953-11-3209 CIPL IN

ADDENDUM A
December 14, 1984

On Page 2-5 of the manual, the equation following Step i should read as follows:

$$Q = \sqrt{f_2 \times f_1} \; / \; (f_1 - f_2)$$

REF. REA NO. 4950